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STATE WATER SURVEY DIVISION
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THIRD ANNUAL REPORT

OF

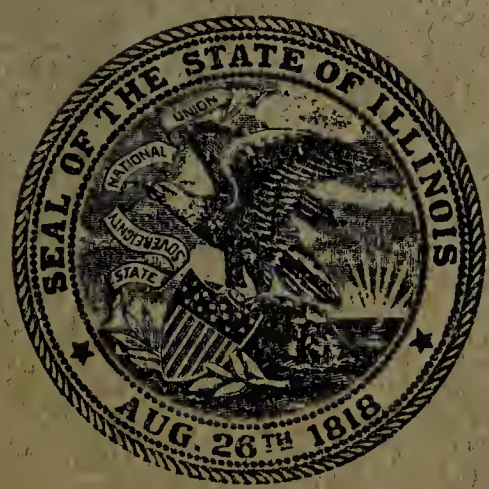
The Department of Public Works and Buildings

Division of Waterways

July 1, 1919

TO

June 30, 1920



FRANK I. BENNETT, Director
THOMAS G. VENNUM, Assistant Director
WILLIAM L. SACKETT, Superintendent,
Division of Waterways

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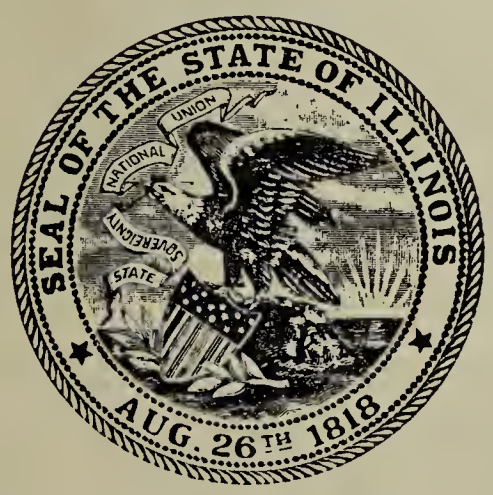

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ent upon any diversion of water from Lake Michigan. The controversy between the Government and Sanitary District of Chicago, as to diversion of water, is still undetermined. Judge K. M. Landis, of the United States District Court, Chicago, June 19, rendered a decision holding the district was unlawfully diverting more water than authorized. If, on final hearing, diversion is restricted to a flow of 4,167 c. f. s., as fixed in the original temporary permit of the Secretary of War in 1901, a serious condition arises, affecting not only health and purity of water supply in Chicago, but the entire Illinois valley which requires careful and immediate serious consideration and drastic protective legislation.

FIRST GOVERNMENT PERMIT

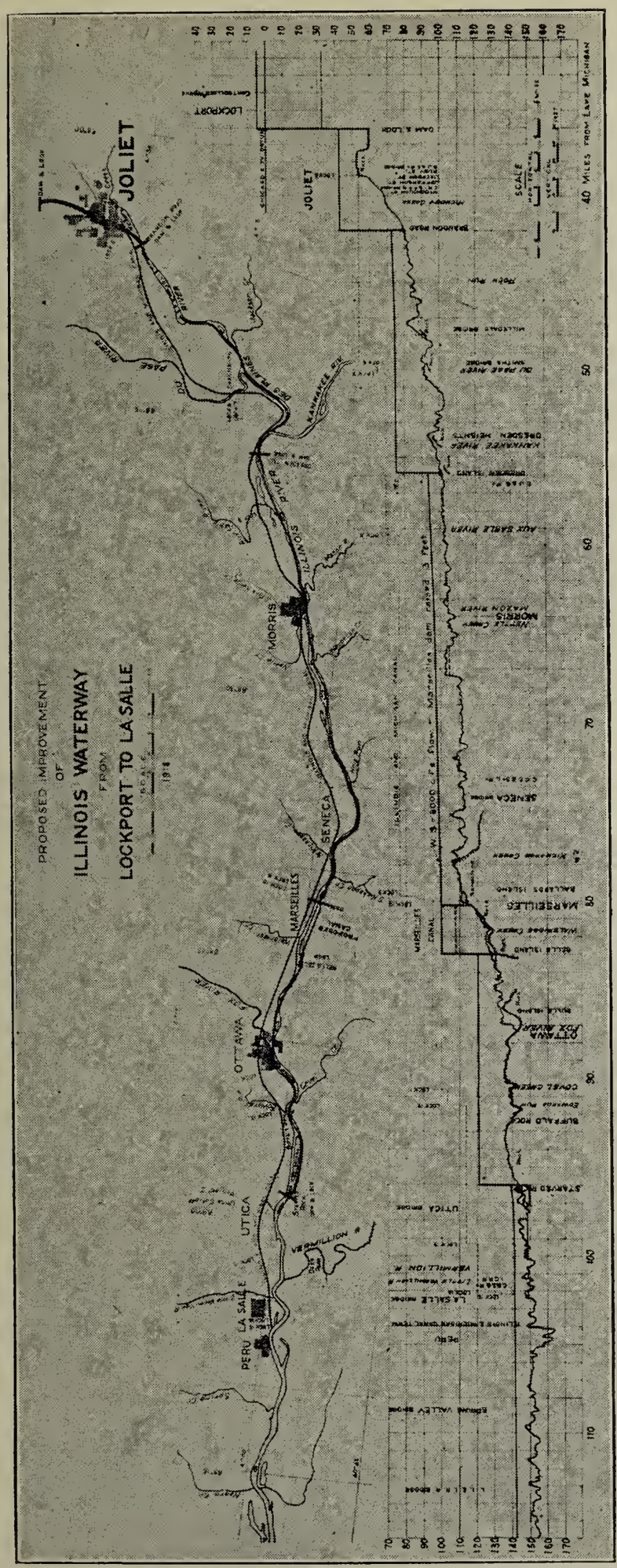
Approval of plans by the Chief of Engineers and permit for construction of the Illinois waterway project by the Secretary of War were given January 6, 1920. Restrictive conditions in this permit were unsatisfactory to officers and engineers of this division. An application for change and modification was made. A hearing was arranged at Washington with the new Chief of Engineers, Lansing H. Beach, in February, 1920, the State being represented by William L. Sackett, superintendent of waterways, M. G. Barnes, chief engineer, and James H. Wilkerson, attorney of Chicago, who had represented the Government as United States District Attorney in the case against the Sanitary District of Chicago relative to water diversion from Lake Michigan, the objectionable conditions in the permit received being based upon this controversy.

The changes and modifications asked by the State were agreed to, and a new approval of plans and permit for construction issued under date of March 6, 1920.

Preparation of detailed plans, a necessary preliminary to letting contracts and actual construction work, involved so great an expenditure, it had been the settled policy of the division that this work should not be undertaken until there had been favorable action by Government engineers and the Secretary of War.

Having been assured in November, 1919, at the conference on plans submitted, of favorable action by Federal engineers, the division then prepared for rushing engineering work and completing plans by organizing an engineering force of well known men of special qualifications for the various branches of the work. Therefore, upon receipt of the revised Federal permit of March 6, 1920, engineering work was progressing rapidly. It was decided first to complete plans for the lock required at Marseilles and the auxiliary channel at that point deemed expedient to best serve the needs of navigation and conserve revenue to the State by additional water power development. It is expected plans will be completed to permit letting of contracts not later than October, 1920.

MAP SHOWING PROPOSED ILLINOIS WATERWAY FROM LOCKPORT TO LASALLE



MANY DIFFICULT PROBLEMS

Many difficult problems are presented in connection with construction of this great project, to overcome which will require diligent and persistent application and hard work. To satisfy people of communities on the immediate line of work as to local conditions will, in some instances, be difficult—not that the division will not make every effort to afford complete protection where municipal work is affected, but because of the demand in connection with this work that the State assume expense in no way legitimately connected with this great enterprise.

Effort has been made for amicable adjustment of claimed power development situations and for the purchase of land necessary for right-of-way and flowage. Large corporate interests, as well as individuals, are to be dealt with. Division officers, while making every effort to deal fairly, must, nevertheless, first serve and protect public interests. Differences of opinion have arisen as to values, which perhaps can only be settled by resort to the courts and condemnation proceedings. This may delay work at some points several months. Options for right-of-way immediately necessary, it is believed, can be obtained at fair prices. It is the plan of the division to ascertain by survey what land is required for flowage, or what will in any way be damaged, and purchase it before starting work.

CONTRACT PROTECTS STATE

The division has been commended for the form of contract to be used in connection with construction work. The contract, initiated by M. G. Barnes, chief engineer, was prepared to meet present uncertain conditions of labor and cost of material. To insure the contractors adequate protection from loss and to preclude claims for "extras," because of change in labor and material conditions, the contract provides, in the event of increase of unit prices after execution, the State shall pay 80 per cent of the increase and the contractor 20 per cent. On the other hand, if there be a drop in prices, the State and contractor are to share equally in the saving. Government engineers, as well as others, have evinced considerable interest in this form of contract, heretofore unknown, and have commended it highly. Heads of surety bonding companies have also expressed belief that such a contract will not only invite greater competition in bidding, but insure against possible bankruptcy resulting from contingencies which might arise because of the unsettled conditions everywhere apparent.

PRESENT CONSTITUTIONAL RESTRICTIONS

The division has devoted much time and thought to the work of the Constitutional Convention and inclusion of an article in the new constitution that will meet present conditions and permit the State in the future properly to maintain and protect its canals and waterways.

The present Constitution, adopted in 1870, provides that the credit of the State shall never be loaned to canals or railroads. Adoption of this provision is generally credited to railroad influences in opposition to development of waterways and canals, fearing competition of that kind. Following the Civil War, demand for transportation was insistent. Railroads were seeking state-aid and land grants. They were undeveloped. The Illinois and Michigan Canal had been a successful factor in handling commerce and paying revenue to the State. Plans for many projected canals were presented.

The State, therefore, had been unable either to maintain adequately or protect the Illinois and Michigan Canal. Only revenues obtained as the result of actual operation for navigation or rentals from portions of its right-of-way could be used for maintenance or repairs. Up to 1889, revenues proved ample to maintain the canal in a reasonable state of repair. Work of the Chicago Sanitary District, organized by act of the legislature, greatly interfered with operations of the Illinois and Michigan Canal between Chicago and Joliet, and when the Sanitary District channel was opened in 1900, giving boats opportunity for navigation from Chicago to Joliet without payment of tolls, it deprived the State of a revenue of upwards of $25,000 a year for tolls on that part of the canal alone, and took from the State a water power revenue at Lockport of about $15,000 a year more, all of which had provided a fund that met ordinary repairs and maintenance, although insufficient to rebuild and enlarge locks to meet the larger carrying capacity of developing railroads.

In 1908, by vote of the people, an amendment to the present Constitution was adopted providing for the issue of bonds for $20,000,000 for construction of the Illinois Waterway from Lockport to Utica and development of water power in connection with its navigation opportunities. It is estimated water power revenue to the State will be from one to two million dollars a year, and this will not only pay the original cost, but in years to come will prove a continuing source of cash return, not estimating its intangible value as an asset in the development of the State.

NEW CONSTITUTIONAL PROPOSALS

Difficulties of administration and protection of State property, maintenance and operation of the Illinois and Michigan Canal, and the general plan of the Illinois Waterway project have been presented to the Constitutional Convention, which convened last January.

The officers of the division devoted several weeks to this work. The following have been reported to the Convention as proper constitutional provisions to meet the difficulties experienced by the State in the past in taking care of its property and for the protection of that which may be developed or acquired in the future:

Section 1.—Bonds in the sum of twenty million dollars heretofore authorized under and pursuant to an amendment to the Constitution of 1870, ratified by the voters on November 3, 1908, and proclaimed adopted November 24, 1908, for the construction, maintenance and equipment of the Illinois Waterway and its appurtenances, when issued and sold, shall be valid obligations of the State, and the proceeds thereof shall be applied to the purposes for which they were authorized.

Section 2.—The General Assembly may make either additional appropriations or may authorize bonds to be issued and sold for the construction, maintenance, operation, extension, enlargement or equipment of the Illinois Waterway, or its appurtenances, in addition to the bonds heretofore authorized; but the aggregate amount of all such additional appropriations and bonds, except as otherwise provided in section 3 of this article, shall not exceed ten million dollars, unless the law making such appropriations or authorizing such bonds shall first have been submitted to a vote of the people of the State at a general election, and have been approved by a majority of all the votes polled at such election.

Section 3.—The gross or total proceeds, receipts and income of the Illinois Waterway and its appurtenances, and of the Illinois and Michigan Canal, may be appropriated or pledged for the construction, maintenance, operation, extension, enlargement, or equipment of such waterway and its appurtenances, or of such canal.

Section 4.—No waterway or canal owned or improved by the State shall be sold or leased, except as provided herein, until the specific proposition for the sale or lease thereof shall have been submitted to the electors of the State and approved by a majority of those voting at the election.

Section 5.—The General Assembly may authorize the lease of the Illinois and Michigan Canal, or any part thereof, for purposes of transportation, or to provide terminals in connection with the Illinois Waterway or other navigable channel. Such terminals shall be for public use upon equal terms.

Section 6.—No appropriation for the Illinois and Michigan Canal shall be made from the State Treasury, except for the maintenance and preservation thereof, from any fund other than the special fund in the treasury arising from the proceeds, receipts and income of such canal.

Section 7.—Leases for water power shall be subject to a revaluation for each twenty years of the term created.

WHY PRESENT CONSTITUTION SHOULD BE CHANGED

It was suggested that section 1 should be adopted for the reason that the waterway policy of the State has been fixed by the amendment to the present Constitution authorizing the issuance of bonds in the sum of $20,000,000 and enactment by the legislature in 1915 providing for the construction of the waterway.

In 1919 the law now in force was enacted to obviate objections raised by Federal engineers and the Secretary of War to details, size of locks and engineering features of the 1915 law. The plans provided under the present law have been approved as being in harmony with the policy of the Federal Government for the improvement of the rivers of the middle-west, the Secretary of War has issued permit for construction of the waterway, and the State is ready to start actual construction.

By the provisions of section 2, the General Assembly would have authority to make appropriations for an additional amount for waterway

purposes, not exceeding $10,000,000, without vote of the people. It was deemed wise to give the legislature this additional authority for the reason that present prices are much in excess of those existing in 1914 and 1915, and unless there should be material reduction in costs, the waterway necessarily will require the expenditure of from three to five million dollars more. By fixing a limit of $10,000,000 on the power of the legislature, it was conceded that public interests would be amply protected. This would insure completion of the plans of the State, and definitely fix the limit of appropriations within a reasonable amount. When the article is submitted the people will have opportunity to vote on the proposition.

Sections 3 and 4 are practically the same as in the present Constitution.

Section 5, if adopted, will enable the State, through the General Assembly, without submitting the proposition to a vote of the people, to lease portions of the Illinois and Michigan Canal between Lockport and Chicago not now essential for purposes of navigation, to be utilized in a general plan for terminal facilities and interchange of freight from railways to the waterway.

The right-of-way of the State extends to the Chicago River and is along the Sanitary District Canal which will be used for navigation. The State has suitable property upon the Chicago River and upon both canals to provide docks, wharves, terminals, and freight houses. By the terms of this section it is provided that these terminals shall be maintained for public use upon equal terms. A very small charge for their use, or for the use of loading or unloading facilities in the transfer of freight, would undoubtedly bring a very large revenue to the State after such terminals were established and in operation.

Section 6 of the proposed article must be read in connection with section 3.

It would seem wise that the State, through the General Assembly, should be placed in a position where it could care for and preserve its property, valued at several millions of dollars. By this section the General Assembly would have power to protect this State property as it protects its other physical property.

Section 7 of the proposed article provides for a revaluation of water power leases every 20 years instead of every 10 years, as provided by the present Constitution. After very careful consideration and study of this problem, the conclusion has been reached it would be more to the interest of the State to have a 20-year period for revaluation.

Under the legislative enactment of 1919, authorizing leases of water power, the period was fixed at 30 years. In recent legislation by Congress for the development of water power throughout the country, the period for leases is fixed at 50 years without provision for revaluation during that time. The right is reserved by the Federal Government to

take over the power at the end of the 50 years upon payment of the appraised value, or upon the amount of cost of the development, or the leases may be extended another 50 years. The legislature followed this plan for the State, but fixed the period of time at 30 years instead of 50.

It is believed it would be a serious handicap and prevent returns of the fullest revenue to the State to require a revaluation each 10 years. This would be true especially if the policy of the State in future was to lease the water or site for development instead of doing the developing itself. This development initially would require a considerable expenditure. Inasmuch as the State does not contemplate going into the business of transmitting light, heat or power, but expects to obtain the revenue that will be afforded by the construction of the waterway by leasing either the water and site, or the generated energy at the plant, it is believed that those municipalities and industries or transmission companies which may be interested in this situation should be given a reasonable time in which to turn over the investment, and that any period less than 20 years will prove a handicap to the State in meeting competitive and market conditions.

M. G. Barnes, chief engineer of the division in charge of waterway construction, submits the following report of engineering work for the period from July 1, 1919, to June 30, 1920:

REPORT OF CHIEF ENGINEER

Owing to the uncertainty of War Department action on the permit for this project and possible action of the Illinois Constitutional Convention, it had been decided to obtain only the nucleus of the engineering organization required for the preparation of plans and the construction of the Illinois Waterway, this nucleus to include specialists for the heads of departments who, from many years of experience in similar work, could assist and advise in the solution of the engineering problems involved and perform any work in connection with the preparation of plans and specifications.

The men so employed during the year, their present positions or titles, principal duties, and so much of their previous experience as peculiarly qualifies them for such duties, are as follows:

J. B. Bassett, division engineer: duties, supervision of work from Marseilles to Starved Rock; experience, fifteen years as assistant engineer, U. S. Engineering Department on the construction and operation of lock waterways.

Murray Blanchard, hydraulic engineer: duties, hydraulic investigations in connection with water power development, flood heights, and channel requirements; experience, five years on surveys and canal construction for U. S. Government, three years on water power development, five years on gaging of St. Lawrence, Detroit, St. Clair and St. Mary's Rivers for U. S. Government, three years on hydraulic investigation of drainage canal for the Sanitary District of Chicago.

L. D. Cornish, assistant chief engineer: duties, as demanded by this title or designated by Chief Engineer; experience, seven years lock and

dam design and construction on the Ohio River for U. S. Engineering Department; six years as designing engineer of locks and appurtenances for the Panama Canal.

Walter M. Smith, designing engineer: duties, in charge of design and preparation of plans for locks, dams and structures appertaining thereto; experience, fourteen years on design and construction of river and harbor works for U. S. Engineering Department; two years on design and construction work for Isthmian Canal Commission and Ordnance Department of the Army; six years as designing engineer of dams, bridges and conduits for Board of Water Supply, New York City; one year private practice on design and construction of hydro-electric plants; five years in charge of designs of flood prevention works for Miami Conservancy District, Dayton, Ohio.

Sutton Van Pelt, construction engineer: duties, general charge of construction work and field representative of the Chief Engineer; experience, four years on construction of water power project at Sault Ste. Marie, Michigan; eight years on construction of locks, dams and channels for the U. S. Engineering Department, on Warrior River and at Sault Ste. Marie, Michigan; two years on construction of harbor improvements; three years as manager of construction for contractors on roads, bridges and sewers.

The engineering force at the end of the fiscal year consisted of the

Chief Engineer.
5 Engineers mentioned above.
3 Assistant Engineers.
4 Draftsmen in the designing division.
1 Assistant Engineer in the field.
4 Men in survey party all in the field.
7 Men in drilling crews all in the field.

Office Work Accomplished.

The force has prepared new maps, plans, cross-sections, and computations, and compiled general information on which Government officials could base their action relative to the application for permit for construction of the Illinois Waterway.

Plans and specifications were completed for the letting of contract for the Marseilles Lock.

Studies and investigations were completed for the general features common to all locks, including walls, filling and emptying system, valves, miter sills, mitering gates; also valve and mitering gate machinery.

About 50 per cent of the designing and drawing for the Starved Rock lock and dam and Marseilles Canal and dam contracts has been completed.

A considerable part of the designing and drawing has been done for mitering lock gates and operating machinery, culvert valves and operating machinery, and Taintor gates and operating machinery.

Extended studies have been made of water power rights along the route of the waterway owned or controlled by various power interests. The amount of power available, its cost of development, and its relation to the waterway project have been determined.

The following list of standard size drawings has been completed:

56 Original designs.
45 Detailed design tracings.
21 Topographical maps from surveys.

19 Finished topographical tracings.
13 Drawings of important studies.
14 Plans and cross-section sketches for estimates.
13 Miscellaneous drawings.
181 Total drawings.

Features of Design.

In the designs for this project an effort has been made to incorporate therein the best features of previous practice, and to eliminate such features of existing locks as have proven unsatisfactory or of doubtful value compared to their cost. The studies made have resulted in the adoption for this waterway of certain features of design, a brief discussion of which it seems desirable should be made a matter of record in the annual report.

The determination of the exact stresses existing in lock walls containing large circular openings is a difficult problem, and in the past two methods of analysis, which give approximate stresses, have been used and the wall sections resulting therefrom, as constructed on the Panama and New York barge canals have proved that these analyses result in safe designs.

One of these methods is the old arch analysis which assumes a design, safe if a line of thrust can be found which is confined to the middle third of all assumed radial joints. The other method is based on the assumption that the sides of the culvert act as elastic columns restrained at top and bottom. The wall designs adopted for the Illinois Waterway have been checked by these methods, but the designs are based on the "least work" method for the analysis of arched structures as described by articles by Walter M. Smith, in the Engineering Record of October 10, 1914, and May 22, 1915. It is believed that the "least work" method, while more laborious, is the most accurate way of determining the stresses, and it results in more economical designs.

The filling and emptying system shown on the plans submitted to the War Department was similar to that adopted for the Panama Canal and the Keokuk Lock on the Mississippi, and, in general, similar to the locks at the "Soo."

Since the construction of the above mentioned locks, several technical papers have been written on the subject of lock filling devices and experience in actual operation has been obtained. From such information it seems evident that this system possesses no material advantages and, in fact, is less satisfactory for inland waterways than the system of filling directly through the side walls, which plan has been adopted for this work with a resultant saving in construction of about $25,000 per lock.

It has heretofore been customary to make the culvert opening at the valve chambers equal to or larger than the culvert itself. Such designs, for large culverts, result in unnecessary cost of construction and accomplish no good purpose. In these designs the principle of the Venturi

meter has been utilized, permitting the use of smaller and, therefore, lighter and cheaper valves. Reports show that a flow coefficient of 1.32 has been obtained for valve openings constructed with 28 feet of water. A coefficient of 1.15 has been assumed for the flow computations of locks for the Illinois Waterway.

For practical reasons the rate of change of water levels usually is limited to about 4 feet per minute. With this limit the velocity in the 12-foot diameter culverts would be about 22 feet, and in valves 9 feet square about 30 feet per second. The velocity head to create this velocity in the culverts is 7.5 feet and to create the 30 feet velocity through the culvert valve there will be a loss of 14 feet, or a difference of 6.5 feet. Herschel's experiments on Venturi meters show that the loss of head is one-ninth, which for this case would be about 9 inches, which loss rapidly decreases as the lock fills. The loss of head due to the smaller valve increases the time of filling less than one minute, and it is believed the time lost is of little consequence and fully compensated for by the decreased cost of the smaller valves and machinery. With this design and the 4 feet per minute limitation, the time of filling or emptying a lock will range from 7 to 12 minutes, depending upon the life or head, and the combined time for filling all 5 locks will be about 44 minutes.

It has heretofore been the custom in the design of mitering gates to permit close contact and heavy bearing between the lower gate girders and miter sill. The result of such a design does not permit an accurate and scientific design of either the lock gate or miter wall. Both must be designed unnecessarily strong to withstand unknown loads. This has been remedied by placing a metal sealing spring on the gate which alone will be in contact with the miter sill when the gate is closed, and which cannot transmit to the sill more than part of the pressure due to the water in contact with the spring. This permits a more accurate and lighter design of both gate and miter wall and results in decidedly lower costs. A further economy in the miter wall results from the adopted design and analysis of same as a horizontal arch instead of the usual design of the gravity type retaining wall.

A thorough investigation of the various types of gates for movable dam structures indicates the desirability of the general adoption of Taintor gates of the single truss or hammer head type. The advantages of Taintor gates lie in the slightly lower cost of the entire dam structure, including the piers and machinery, the greater ease of counterweighting, and the fact that this type of gate is more certain of easy operation under ice conditions.

Mitering gates of large size have usually been designed with flat plate skins on both the up-stream and down-stream side. Investigation develops that the double skin type possesses no material advantages, except where air chambers are required for buoyancy effect to reduce the operating stresses on the pintles and yoke pins. The use of buckle plates

results in smaller costs than for flat skin plate design, and has been adopted. Single skins on the down-stream side have been adopted except for the lower 15 feet of the lower gates at Lockport, and Brandon Road, for which air chambers are advisable.

New Form of Contract.

The usual type of unit price lump sum contract is unsatisfactory on account of the disinclination of contractors to assume the risk involved under present labor and material price conditions. The cost plus profit contract is much desired by contractors, but is not to the interests of the State as there is not sufficient inducement for the contractor to keep down the cost.

To cover abnormal labor and material conditions, the contract and specifications have been so drawn that the contractor will base his bid on prices of labor and materials scheduled therein. A provision is made whereby the State assumes 80 per cent of the cost of labor and material in excess of the maximum prices scheduled, and the contractor assumes the remaining 20 per cent. Another provision of the contract stipulates that the contractor and State shall share equally in all saving due to prices being below the minimum prices scheduled. It is believed that owing to these provisions there will be more competition for the contracts and lower bids will be obtained.

Field Work Accomplished.

To obtain stream data for designing purposes, a gauging station was established at Morris; cross sections of the Illinois River from Bell's Island to Ottawa were taken at stations 500 feet apart, and levels were run to establish the surface slope of the DesPlaines River from Joliet to Dresden Island and also for several miles above and below the Marseilles dam.

One survey party has been continuously engaged in work required in connection with existing or claimed power rights and for the acquisition by the State of land for construction purposes and of land which will be overflowed by reason of proposed construction of dams. Progress on this work has been handicapped from a lack of public data relative to location of section corners, and taking this and the small survey party into consideration, the progress has been fairly satisfactory. Assistant Engineer M. C. Lewis, who is in local charge of work for land appropriation, states the work would have progressed very slowly indeed had it not been for the extreme courtesy and able assistance gratuitously rendered by Mr. William H. Irwin, county surveyor of LaSalle County, who placed his files, records and personal knowledge at the service of the State.

Drilling Operations.

During the year drilling operations were inaugurated to determine if suitable rock for foundation purposes existed at the proposed locations

of structures. Such work has been completed for the Marseilles lock, and 60 per cent completed for the Starved Rock lock and dam sites, and the location of the Marseilles canal and islands in the Illinois River above Ottawa were likewise investigated to obtain data for the estimate of rock excavation.

This work was performed under contract by the Pennsylvania Drilling Company, and was the only contract work performed during the fiscal year. The first contract with this company, dated October 20, 1919, was for making diamond drill borings at the Marseilles lock site. Twenty holes were drilled, and the contract was completed in December, 1919. A supplementary contract for the Marseilles canal borings was entered into in December, 1919, and completed in January, 1920, under which 11 holes were drilled. The material found was generally clay overlying a shale formation. The results obtained were satisfactory. All equipment, labor and services for these contracts were furnished complete by the contractor.

On March 11, 1920, another contract was let to the same company for 3,000 linear feet of core borings to be made at the Starved Rock, Brandon Road and Dresden Island lock and dam sites. In this contract the contractor furnished and maintained the drill outfits at a unit price per foot. Floating equipment, labor, gas, oil, supplies, and other expenses were to be paid for directly by the State. Owing to the varied conditions, the spread of locations, and extra equipment needed, it was deemed to be for the best interest of the State to do the work and pay for it in this manner.

Drilling on this contract started at Starved Rock on May 19, 1920. To the end of the fiscal year 607 linear feet of holes, or about 20 per cent of the contract, was completed. The rock encountered at Starved Rock was sandstone underlaid by limestone, which latter contained considerable quantities of small, flinty particles, which were exceedingly destructive to the diamonds in the bits, the damage being due to breakage of diamonds. It is expected that this contract will be completed by December 1, 1920.

M. G. Barnes, *Chief Engineer.*

ENCROACHMENTS

Investigating complaints of and preventing encroachments upon streams has required much time and attention of the division.

Unauthorized encroachments upon Lake Michigan have been practically stopped. Many serious problems in this connection have been presented. Several applications for permits have been denied as not being in the public interest. At some points encroachments have reduced the capacity of the streams to an extent preventing proper disposal of flood waters and damage has resulted.

The division has required removal of encroachments on the Kankakee and Fox Rivers at various points. A material narrowing of the

Rock River, near Morgan Street, Rockford, and above, by encroachments beyond the shore line established by the Federal Government in 1912, caused apprehension of damage and presented a situation that might easily lead to loss of life as well as property following an unusually heavy rainfall. A somewhat similar condition, but more extended territorially, caused the Dayton flood.

The division sought agreement with all violating the law at this point by which the encroachment would be removed and criminal prosecution avoided. Permits have been issued and work has been done in three cases. The city of Rockford and one corporation have constructed substantial shore walls which will preclude any further encroachment beyond the established shore line. Another company has removed the encroachment to the shore line agreed upon, but owing to high costs and transportation handicaps could not complete the wall.

In one case suit to impose penalties for violation of law and to compel removal of the encroachment will be necessary. There will be other cases if pending negotiations shall fail in reaching satisfactory agreements.

In most cases of complaints of this character hearty cooperation has been given the division. Its engineers have given valuable assistance in surveys and locating shore lines. Many encroachments have been made without knowledge of flood dangers or damage, and the work of our engineers and information given the public have been of great value.

As a result of the activity of the division and continuous inspection of the lakes and streams of the State by its own representatives, assisted by representatives of the Division of Fish and Game, the provisions of the law enacted by the Fifty-first General Assembly for control of streams are proving effective.

WHAT THE LAW PROVIDES

The law provides:

> It shall be unlawful to make any fill or deposit of rock, earth, sand, or other material, or any refuse matter of any kind or description, or build or commence the building of any wharf, pier, dolphin, boom, wier, breakwater, bulkhead, jetty, or other structure, or to do any work of any kind whatsoever in any of the public bodies of water within the State of Illinois, without first submitting the plans, profiles and specifications therefor, and such other data and information as may be required, to the Department of Public Works and Buildings of the State, and receiving a permit therefor signed by the Director of said department and authenticated by the seal thereof; and any person, corporation, company, city, or municipality or other agency, which shall do any of the things above prohibited, without securing a permit therefor as above provided, shall, upon conviction thereof, be fined in a sum not exceeding five thousand dollars or be imprisoned in the county jail not exceeding one year, or may in the discretion of the court be punished by both fine and imprisonment. Any structure, fill or deposit erected or made in any of the public bodies of water of this State, in violation of the provisions of this section, is hereby declared to be a purpresture and may be abated as such at the expense of the person, corporation, company, city, municipality, or other agency responsible therefor.

Section 23.—It shall be the duty of the Department of Public Works and Buildings to maintain stream gauge stations, and to make careful investigations of the streams of the State with reference to the carrying capacity of all such streams in times of flood and under normal conditions; to prevent the carrying capacity of streams to be limited and impaired by fills, deposits, obstructions, encroachments therein or bridges over same, to an extent where the same cannot safely dispose of the flood waters which may naturally, lawfully and properly be discharged therein; to require such changes in bridges across any navigable waters or streams, or bodies of water made navigable, necessary to meet the demands of navigation and commerce thereon. If the capacity of any stream is limited and impaired by reason of any of the acts or construction in this act provided, so as to constitute a menace to property along the course of said stream or safety of the people of the State, or results in damage, overflow, or an interruption to navigation, said Department of Public Works and Buildings shall take such action as may be required, by injunction or otherwise, to prevent such encroachments or the erection of such structures, or compel the removal or modification of same. It shall be unlawful for any person, persons, corporations, counties, cities, municipalities, or other agency to make any fill, deposit or encroachment in, or erect any bridges, over any of the streams of this State, until plans, profiles and specifications, and other data which may be required, have been first filed with the said Department of Public Works and Buildings of this State, and a written permit received therefor.

The Department of Public Works and Buildings is authorized, in case of existing dams, to require said dams to be maintained in a proper state of repair and at a height for proper control of water levels in the disposal of flood waters and at normal stages, and for such purposes to require changes and modifications therein, and to compel the installation of fishways in existing dams wherever deemed necessary.

Submission of plans gives the division knowledge of proposed work, opportunity for investigation, and enables its engineers to determine whether private or public damage will result.

COMPLAINTS OF STREAM POLLUTION

Several complaints have been received of pollution of streams in various portions of the State. Considerable time and exhaustive investigation are necessary to get facts in many cases. Others require preventive methods easily provided.

Complaints of pollution in the State arise from the discharge of industrial or waste products, or of sewage from municipalities, into small streams where the flow of water is insufficient to carry the load or give adequate dilution.

Serious problems are involved in sanitary sewage disposal. Stream pollution is depriving the public of legitimate use of the waters therein. For years streams, not only in Illinois, but in many states, have been accepted as a natural means of sewage disposal. Increased development and growth of population has resulted in a load of sewage or industrial waste that the streams can no longer carry with due regard to public health or to the use of the streams for stock on the farms.

Several states have laws requiring sewage treatment to avoid stream pollution. Such laws would be a progressive step in Illinois of great

public benefit. Interest is gradually being aroused among the municipalities of the State, and a number of them with progressive officials are trying to provide sewer systems with modern methods of treating and separating solids so there will be no objectionable effluent going into streams of the State. Not only are sewage treatment plants necessary, but there must be efficient operation. There are over one hundred municipalities or plants in the State today having sewage treatment plants of varying types. Many of these do not receive proper care, nothing is done to keep them in repair and operation is under incompetent direction. Sewage treatment plants cannot be expected to operate without care and attention. Engineers of this division have and will be assigned whenever so requested, to indicate repairs required for proper operation and to instruct men in charge as to proper methods of operation.

This division renders all engineering assistance possible. All communities have a class of objectors who make difficult real progress in these matters. The division will be compelled, in case of failure to accomplish satisfactory results by negotiation, to request suits to abate nuisances resulting from insanitary methods of sewage disposal.

MODERN METHODS AT DECATUR

This division cites the city of Decatur as one municipality where the people have awakened to a realization of the seriousness of sewage disposal. Water supply for domestic and manufacturing use is a stimulating factor in solving the sewage disposal problem. Complaints of the method of disposal of sewage into the Sangamon River by Decatur were filed with the State, resulting in an order to discontinue the practice.

Decatur has a population of about 50,000. Its sewage flow is about 5,500,000 gallons per 24 hours. Included in this is about 1,250,000 gallons of strong industrial waste from a starch factory, exclusive of condenser water. There is also included the sewage and wastes from a creamery, packing house and gas-works. The city sewage, without the industrial sewage, has a biological oxygen consumed value of 171 p. p. m. The minimum required volume of diluting water for the latter figure is about 40. Sewage treatment is required because during three or four months in the summer the entire flow of the Sangamon River is used for the water supply of the city and is subsequently turned back into the stream as sewage. This creates an open sewer passing by the city and continuing in a lessening degree for twenty miles below.

Even with the use of the whole dry-weather flow the river is insufficient for the water supply needs of the city and consequently a large storage dam is under construction. This will afford water for sewage dilution also.

Attention of this division was directed to the work of the city by submission of plans for the storage dam and application for permit. Changes in construction were suggested by State engineers to strengthen

the structure and insure protection to life and property. The division gave its cooperation in settling disputes and insuring protection to property and payment of damage. The division believes this a case where the requirements of the present law were found of value in protecting community and public interests.

The division suggests that all Illinois cities having a sewage disposal problem to meet can get much valuable information from the experience of Decatur.

A number of special tests of sewage treatment processes have been made. A testing station comprising an Imhoff tank and sprinkling filter with appurtenances, was built in 1914 and operated during 1914, 1915, and 1917. During 1917 small-scale tests were made of the activated sludge process on the mixed sewage, and in 1919 a testing station was built and operated to try the activated sludge process on the crude starch works sewage. It was found that the activated sludge process is applicable to the mixture of city and starch works sewage, but not to the starch works sewage alone. The tests also showed that Imhoff tanks removed 50 to 60 per cent of the suspended solids from the mixed sewage, and that sprinkling filters operating with settled sewage at a maximum rate of 1,000,000 gallons per acre per 24 hours would produce a 90 per cent stable effluent.

Final decision has not been made of the particular type of treatment plant that will be used. The total improvement will cost approximately $2,000,000.

IMPORTANCE OF STREAM GAGING RECORDS

During the fiscal year ending June 30, 1920, the Division of Waterways, in cooperation with the U. S. Geological Survey, maintained 25 gaging stations on the principal rivers in the State. At each of these stations a continuous record of the daily stage and flow was obtained. These records have a number of valuable uses. By means of two of the stations the amount of water being diverted from Lake Michigan through the Sanitary Canal is determined. Records are also collected on the principal streams tributary to the Illinois River, thus giving a complete inventory of the flow of the stream, a most vital factor in determining the amount of power that can be developed at the proposed water power plants in connection with the waterway.

Streams in the southern part of the State frequently overflow their banks, inundating large tracts of fertile land and inflicting heavy damage on the crops. Surveys and tentative plans for improving several of these streams have already been made, and as the price of farm lands increases others undoubtedly will be made. In planning these improvements it is essential to know the frequency, duration, and magnitude of the floods, as well as the ordinary and low flows. These data are obtained by the gaging stations on the most important streams in that section. The same is true of streams in the northern part of the State.

The records of flow of streams are of great value. The division has many calls for them and its engineers are frequently called upon to produce them in settlement of disputes. They also preclude construction that will prevent disposal of flood waters resulting in overflow and damage.

ILLINOIS AND MICHIGAN CANAL

There has been a gratifying increase in navigation and transportation over the Illinois and Michigan Canal and Illinois River during the period from July 1, 1919, to June 30, 1920. This in spite of inadequate size of locks and extensive damage by unusual flood conditions in March, April and May of 1920, which prevented use of the canal the first three months of the navigation season, and damage by cyclone in July, 1919, which obstructed portions of the canal a month during the season of greatest demand for navigation. All this required an unusual expenditure for maintenance, but earnings have been sufficient to pay it.

A flood March 24, 1920, destroyed 65 feet, or about one-third of a retaining dam at Channahon in the DuPage River. This prevented maintenance of water levels in the entire canal west, a distance of 50 miles, stopping all navigation. Continued high water for six weeks prevented reconstruction work until June 14. It will require at least six weeks for contractors to complete it.

April 26, 1920, a cloudburst and flood did considerable damage to canal banks and a large culvert at Marseilles, requiring extensive repairs and adding materially to maintenance expense.

In October, 1919, buildings and locks at Copperas Creek in the Illinois River were repaired. The dyke protecting State property was partially rebuilt. The dyke furnishes a road for ingress and egress to the locks. The work could not be completed before freezing weather in December, 1919. Large sections of the dyke were carried out by the floods of March, 1920, causing a loss of several thousand dollars.

The work on the dyke has not been resumed this year, awaiting work by the Waukonda Drainage District, now organized, and by other drainage organizations that have suggested cooperative plans for permanently overcoming annual damage from floods in that vicinity. If the State resumes the work, a much larger appropriation is necessary than made by the Fifty-first General Assembly for it.

Other unusual repairs have been necessary to locks, gates, houses and floating equipment which have required a large expenditure.

FOX RIVER FEEDER

An application for Federal permit to construct a dam in the Fox River at Dayton, five miles north of Ottawa, brought to the attention of the division adverse claims to property at that point. The permit for the dam was refused by the Government upon the representations of this division that the State had property rights.

Investigation by the division indicates that these adverse claims are without foundation; that the State owns in fee the bed of the feeder; that it has property interests at the site of the dam, and has a perpetual contract for three-fourths of the water flowing in the Fox River for power development at Dayton. Investigation of the records of the Canal Commissioners does not show any official action indicating abandonment.

This investigation was in progress when report for last year was made. Legal questions involved had been referred to the Attorney General for opinion. The position of department and division officers is sustained. A lease of State rights has been discussed with those desiring to utilize the situation for power development, but no contract completed. Litigation may result from the situation. The State will allow no work unless its rights are recognized and acquired by legal process.

SUITS TO RECOVER STATE LANDS

To establish title of the State to the right-of-way of the Illinois and Michigan Canal and to obtain the evidence necessary to a successful trial of cases now pending in the Cook County Circuit Court against various individuals and corporations that have entered upon and occupied this property, it has been necessary to make an exhaustive examination of the records of the canal covering the period from 1822 to the present time, and records in the counties of Cook, Will, Grundy and LaSalle.

This investigation is requiring the handling and copying of thousands of documents, numerous plats, maps and field notes of early surveys, and other data, examination of documents in the offices of the Auditor and Secretary of State at Springfield, and a very large correspondence. Valuable records have been located, including the original book of proceedings of the Canal Commissioners for the period 1829 to 1833, notes of original surveys, and other data of importance.

This work is by no means complete, and will continue for several months. The division has already obtained much documentary evidence up to this time, and is confident the claims of the State will be upheld when these cases reach trial and introduction of evidence is permitted. Preliminary arguments are to be heard in September.

The property involved in the pending suits is located in sections 30 and 36 in Cook County. The original survey of the right-of-way in these sections has been relocated by engineers of the division, plats made, and the information given the Attorney General. This survey and completion of necessary maps required several months. Many difficulties were found in locating the original marks.

From the information thus obtained it would appear that the right-of-way of the State is more extensive than heretofore believed. The evidence discovered, the division believes, will result in a reversal of opinion by the courts of the State in cases heretofore tried and de-

termined, in none of which was evidence introduced such as is now found.

The property within Cook County, which corporations and individuals have sought to seize and hold, is valued at several hundred thousand dollars. If these cases are decided in favor of the State, lands representing a value of millions will be recovered.

Knowledge of the pending suits has resulted in a waiver of claim by a number of individuals to property seized and occupied, and the division has been able to execute leases with this class of squatters, confirming title in the State.

In an action against George Donnersberger, who has occupied and claims a large tract of this State property, the State Supreme Court has already given a decision favorable to the State. Donnersberger sought to confirm his title to the property by procuring the issue of a Torrens land registration certificate from the Recorder of Cook County. The Attorney General, acting for the division, contended title could not be acquired against the State in this manner, and the court sustained the contention.

The Fifty-first General Assembly authorized a resurvey of the entire canal for the purpose of relocating the original surveys. It has been impossible for the division to accomplish this work except at a few points where the need was most pressing. The time of its engineers and investigators has been given entirely to work immediately necessary in connection with pending suits affecting property in sections 30 and 36. Enough has been done to establish the fact that property of the State is occupied by squatters at many points.

Receipts and expenditures are as follows:

RECEIPTS

	July 1, 1918, to July 1, 1919.	July 1, 1919, to July 1, 1920.
90-foot strip lots and bridge rentals	$13,752.10	$ 9,080.46
Water power rentals	11,665.20	17,364.68
House boat, boat house rentals and level licenses	273.50	307.50
Water pipe rentals and miscellaneous	7,295.17	7,400.27
Ice leases	1,042.00	1,057.00
Certified copies	17.50	45.00
Tolls	682.36	1,594.79
Total	$34,727.83	$36,849.70

EXPENDITURES.

	July 1, 1918, to July 1, 1919.	July 1, 1919, to July 1, 1920.
Illinois and Michigan Canal	$23,133.03	$32,119.04
Illinois River and Locks	13,578.36	11,496.74

SUMMARY SPECIAL CANAL FUND.

Balance on hand July 1, 1919		$23,402.49
Receipts July 1, 1919, to July 1, 1920	$36,849.70	
Expenditures July 1, 1919, to July 1, 1920	32,119.04	
		4,730.66
Balance on hand July 1, 1920		$28,133.15

The number of boats navigating the canal, clearances issued, and tons transported through the Illinois and Michigan Canal and locks at Henry and Copperas Creek in the Illinois River follows:

COPPERAS CREEK LOCKS.

	July 1, 1918, to July 1, 1919.	July 1, 1919, to July 1, 1920.
Tolls	$164.73	$645.32
Boats cleared	48	219
Number of passengers	24	1,697
Tons transported	2,815	10,011
Consisiting of—		
Corn	16,800 bu.	.....
Oats	75 bu.	.....
Wheat	62,079 bu.	228,900 bu.
Coal	175 tons	811 tons
Merchandise	613,273 lbs.	1,030,510 lbs.
Molasses	.....	3,638,016 lbs.

HENRY

	July 1, 1918, to July 1, 1919.	July 1, 1919, to July 1, 1920.
Tolls	$315.65	$488.40
Boats cleared	109	205
Number of passengers	9	1,390
Tons transported	6,000	3,744
Consisting of—		
Corn	46,523 bu.	60,836 bu.
Oats	82,000 bu.	44,500 bu.
Wheat	29,731 bu.	43,000 bu.
Rye	22,000 bu.	13,500 bu.
Barley	2,000 bu.	.....
Sand	1,650 tons	700 tons
Coal	150 tons	.....
Merchandise	59,460 lbs.	225,100 lbs.

JOLIET

	July 1, 1918, to July 1, 1919.	July 1, 1919, to July 1, 1920.
Boats cleared	55	77
Tolls	$164.47	$339.43

OTTAWA

	July 1, 1918, to July 1, 1919.	July 1, 1919, to July 1, 1920.
Boats cleared	20	37
Tolls	$64.28	$102.75

ILLINOIS RIVER POLLUTION

In his first engineering report on the Illinois Waterway project in 1917, M. G. Barnes, chief engineer, directed attention to the importance to the State of a determination of the controversy between the Government and the Sanitary District of Chicago over the quantity of water diverted from Lake Michigan for diluting sewage discharged from the Sanitary District channel into the DesPlaines and Illinois Rivers.

The temporary permit of the Government issued in 1901 provided for a diversion of 4,167 c. f. s. This flow has been inadequate for sanitary purposes for several years, and conditions arising from pollution are such as will seriously interfere with navigation if not remedied.

June 20, Judge Landis, in the United States District Court, handed down a decision in litigation started in 1908, upholding the contention of the Federal Government that the Sanitary District cannot lawfully divert from Lake Michigan more than 4,167 c. f. s. of water for sanitary purposes. Entry of final decree is delayed until 60 days after the convening of the U. S. Supreme Court in October to allow opportunity of appeal by the Sanitary District of Chicago. Should the final decree of the courts restrict diversion to 4,167 c. f. s., serious problems are presented.

Dilution method of sewage has been relied upon by Chicago under provisions of State law requiring a diversion of water from Lake Michigan of 3⅓ c. f. s. per thousand of population. This, authorities agree, is a lower percentage of dilution than required in many cases. Based on present population the provision of State law requires a diversion of approximately 10,000 c. f. s. Even this flow imperils the water supply of Chicago, at times seriously, while throughout the Illinois valley there is general complaint of stream pollution.

Notwithstanding the pending suit, knowledge of Government opposition to a diversion of water from Lake Michigan regardless of requirements of State law, dangers of an adverse decision of the courts, and inadequacy of dilution method of sewage disposal in view of growth of population in Chicago and objectionable stream pollution down State, the Sanitary District administration has been expending large sums for projects other than sewage disposal, instead of pushing construction of treatment plants for separating the solids and chemically treating the effluent to render it innocuous. At the end of twenty years, construction of treatment plants is not now more than in an experimental stage for an exceedingly small percentage of total area. It is expected the district will complete the auxiliary Sag channel by the fall of 1921. It has been announced that no additional sewage will be sent down this channel into the DesPlaines and Illinois Rivers without treatment, yet the contract for the treatment plant has only recently been let. Accepting in good faith the statement that the plant will be completed in two years, this means some time in 1923, at least two years after the channel may be completed and ready for water flow. In view of past experience, it may be assumed there will be delays, that the plant will not be completed within a two year period, and the question arises, will the rivers down State be given an additional raw sewage load to carry in their already overburdened condition?

LITTLE PROGRESS IN SEWAGE TREATMENT

Up to the present time all the work of the Sanitary District of Chicago in providing plants for sewage treatment is covered by the following:

The Calumet or Sag channel plant above referred to for which contract has been let to serve an estimated present population of about 200,000.

The Maywood plant and Morton Grove plant in the upper Des-Plaines River district which will serve present population of about 55,000. Work on the Calumet plant has not yet started. Work on the Maywood plant started two or three years ago, and it is only about one-fourth completed at this time. The Morton Grove plant is a small, isolated plant to care for the few hundred people in that village alone, and has no effect on the main proposition.

All these plants will provide sewage treatment for present population of 255,000 people, or about 8 per cent of the total. It was announced several months ago that an agreement had been reached with stockyards interests by the Sanitary District for the construction of a plant to treat waste and sewage of the packing house district. It is asserted if these wastes were separated and treated, it would mean a relief of polluted conditions equivalent to household sewage of a million people.

It is planned, this division is advised, to put in screens for the stockyards plant when work is started, and to build a proposed activated sludge plant in sections, the first section to represent only about 5 per cent of the whole. It may be anticipated from this that a completed plant is identified with some future period that means no immediate relief to people of Chicago or down State. More than this, the division is advised, the agreement with the stockyards interests, by which costs are to be divided, is not yet signed. Therefore, the entire plan may result in nothing tangible. In any event, in view of present progress, no improvement can be expected for several years so far as stock yard wastes and sewage contribute to the general condition of pollution complained of.

There are admittedly serious problems of engineering and expense involved, but neither is as serious as the question of pure water supply for the city of Chicago and prevention of epidemics of disease throughout the Illinois valley by use of the rivers as open sewers in disregard of modern methods of sewage treatment, work on installation of which should be pushed without further delay.

FORMER THEORIES DISPROVED

Originally the contention of eminent sanitary and construction engineers was that the solids and wastes in the sewage discharged into the streams by Chicago would not travel beyond the limits of the Sanitary District Canal, but would be diluted, settle, or be sufficiently treated by process of aeration to be innocuous. But it has been found the sewage does travel and that the DesPlaines and Illinois Rivers, into the first of which it is discharged at Lockport, are seriously polluted to Peoria.

Later evidences are reported as far as Havana, a distance of 205 miles from Chicago.

If the Sanitary District constructs works in the Niagara River to control and prevent lowering of lake levels, approval of both the United States Government and Canada must be obtained. Adverse interests may interpose objections that may seriously delay, if not wholly defeat, this proposal. Whatever may be accomplished to obtain a Government permit for a greater diversion from Lake Michigan of more than 4,167 c. f. s., fixed in the temporary permit of 1901, it is known that no authorization can be had for a flow that will abate the present objectionable conditions down State, or be sufficient for adequate sewage treatment by means of dilution.

There is but one specific and permanent remedy. That is construction of plants for scientific treatment of sewage by modern methods. Engineers agree, and this division admits, it will be a great problem to design and construct such works and keep pace with future increase in population, saying nothing of the needs of the present population. The little that has been done is inconsequental, although often announced as adequate and comprehensive. The health, the lives of the people of Chicago are endangered by inactivity and procrastination in pushing work for proper sanitary sewage disposal by chemical treatment, now that the limit of the dilution method has been reached.

HEALTH AND LIFE ENDANGERED

The DesPlaines and Illinois Rivers are badly polluted, and for years have been unfit for bathing or domestic use, or for stock, and the fish industry has been completely destroyed as far down as Peoria. The stench at times in the summer season is offensive and is also a damage to navigation.

Delay in inaugurating and providing for financing a settled policy of constructing adequate sewage treatment plants, permitting completion of a definite number of units annually, is endangering the lives and health, as well as the water supply of the people of Chicago and residents of the Illinois valley, and apparently the seriousness of the situation is giving little concern.

Down State communities are already aroused to an opposition to Chicago extremely unfortunate, yet invited by a continuance of a condition that can be obviated and reduced to a degree each year, although 25 years may be required to bring about the entire relief required by reasonable health consideration. Every dollar expended by the Sanitary District in work other than construction of modern sanitary treatment plant units with resulting delay, is imperilling the health and water supply of the people of Chicago.

This division submits there should be such amendment to present legislation, or additional legislation giving some agency, State or otherwise, such control as will insure that this work will be pushed, prevent

expenditure of funds for anything but sanitary purposes, insure just treatment and protection to people throughout the Illinois valley already enduring inestimable damage, and prevent the calamity certain to overtake the people of Chicago unless a scientific method of sewage treatment, in addition to the present outgrown plan of water dilution, is installed and made serviceable without unnecessary delay.

CONDITIONS FOUND IN 1918

This division received several complaints from citizens and municipalities in 1918.

Stephen A. Forbes, chief of the State Natural History Survey Division, having made a survey and investigated the extent of pollution in the river in 1911 and 1912, it was only necessary to make another survey in the summer of 1918 for comparison. This division in July, 1918, requested such a survey be made from Peoria upward, especially to determine whether pollution was increasing or diminishing. A party consisting of R. E. Richardson, in charge, Miss Amelia Jewell, biologists of the Natural History Survey and the Water Survey respectively, G. C. Baker, one of the chemists of the Water Survey, and W. W. Means, an engineer experienced in river work, was organized for the work.

The report received by this division from Mr. Forbes follows:

NATURAL HISTORY DIVISION REPORT

The field operations of this party began July 22, 1918, at Depue, 60 miles below the origin of the Illinois, and were carried down from that point over a stretch of the river 60 miles in length to Pekin, where they were finished August 31. Determinations of dissolved oxygen in the river water were made at Depue, Hennepin, Henry, Lacon, Chillicothe, Alfresco Park, (just above Peoria), Peoria Narrows, (in Peoria Lake), and Pekin. Quantitative collections of the minute plant and animal forms of the water (the so-called plankton), and of the animal forms of the bottom sediments were made at all the above points except Depue. The chemical and biological data thus obtained in the summer of 1918 may be compared with a similar record of oxygen determinations, and of collections of plants and animals from the bottom and the current of the river, obtained July 11 to September 6, 1911-12, at all the above points with the exception of Alfresco Park and Peoria Narrows.

From the following comparative table of oxygen ratios it will be seen that dissolved oxygen was several times more abundant in the water at those points six and seven years ago than it was last summer, the difference diminishing gradually downstream from a ratio of 1 to 16.6 at Depue to a ratio of 1 to 2.8 at Chillicothe, and 2.7 at Pekin.

Otherwise stated, oxygen was nearly seventeen times as abundant in the river water opposite Depue in September, 1911 and 1912, as it was in July, 1918, while at Chillicothe it was 2.8 times as abundant in July and August, 1911 and 1912, as it was in August, 1918, the ratios at

intervening points from above downward being 1 to 9.6, 1 to 3.6, and 1 to 2.7.

RATIOS OF DISSOLVED OXYGEN IN ILLINOIS RIVER WATER, STATED IN PARTS PER MILLION, SUMMERS OF 1911 AND 1912 IN COMPARISON WITH SUMMER OF 1918

Stations.	Parts per million 1911-1912.	Parts per million 1918.	Ratios of later period to earlier.
Depue	2 65	0 16	1—16.6
Hennepin	2 41	0 25	1— 9.6
Henry	2 35	0 65	1— 3.6
Lacon	2 45	0 92	1— 2.7
Chillicothe	3 27	1 17	1— 2.8
Pekin	5 61	2 08	1— 2.7

What these oxygen ratios signify as compared with those of a tolerably clean water may be shown by a comparison with the ratios of dissolved oxygen for the Kankakee and with those of Depue Lake. August 21, 1911, the oxygen of the Kankakee River just above its mouth stood at 8.47 parts per million at 10 a. m., and at 10.15 parts per million at 2 p. m., the increased ratio in the afternoon being due to the oxygen given off by water-plants under the influence of sunshine; while in Depue Lake, September 11, 1911, the oxygen ratio stood at 12.92 parts per million when that of the river just above the lake was 2.65 parts per million.

The biological data were of the same general tenor, although a little less definite in the details of the comparison. The most important single biological indication of the reach of pollutional conditions now as compared with those of six years ago was given by a well-known characteristic sewage fungus, Sphaerotilus natans. Although extremely abundant in the river at Morris and Marseilles in 1911, this fungus diminished rapidly down-stream at that time and disappeared from both channel waters and the shore at or above Starved Rock, 16 miles below Marseilles, but August 28-30, 1918, small clusters of it were common in the water at Hennepin, 23 miles below Starved Rock, and were present also as far south as Henry and Lacon, 35 and 42 miles below that point. Microscopic examination of specimens taken at Hennepin and Henry showed that the filaments of the fungus were perfectly healthy, and that cell division was in progress, an indication that the water was still sufficiently foul to nourish this sewage fungus, which perishes when the water becomes fairly pure.

Two minute floating plants of the kind known as diatoms (Tabellaria flocculosa and fenestrata), very abundant in Lake Michigan but not found in the Illinois River until after the opening of the Sanitary Canal in 1900, were brought into the river in great numbers in the canal water in 1910, but gradually diminished in numbers until they reached Chillicothe, where the water became clean enough to permit their multi-

plication and rapid increase in the river below; but in 1918 they continued to diminish in numbers down-stream past Chillicothe and almost completely disappeared from the river at Pekin, 27 miles beyond that point. Still another lake diatom, (Melosira granulata var. spinosa), more tolerant of foul water than the two just mentioned, persisted in the river through the worst sewage mixtures in 1910 and 1911 and began to multiply rapidly again at Spring Valley and Hennepin, while in 1918 it first began to increase in number below Chillicothe, 28 miles from Hennepin. From these biological data we may fairly say that the line of division between contaminated and tolerably clean water, although indefinite at all times, has moved from thirty to forty miles down stream during the past six years.

On the other hand, for chemical conditions equivalent to those found at Chillicothe this year, we should have had, seven years ago, to go 67 miles up the river to the Marseilles dam where the ratio of dissolved oxygen was 1.65 parts per million August 14, 1911, as compared with 1.17 parts per million at Chillicothe August 30, 1918. In other words, if we apply the chemical yardstick, we find that pollutional conditions which disappeared at Marseilles in the summer of 1911 persisted in 1918 as far down as Chillicothe, 67 miles below.

In judging the meaning of these comparisons we should take account of possible differences of river levels and the consequent rate of flow in the two periods compared; but I find that gage readings at Peoria show an average of only six inches lower water during the earlier period than during the later—too little to have had any appreciable influence on our problem. On the whole, we are warranted in saying that pollution of the flowing stream by Chicago sewage has greatly increased since 1912, and that it now continues in a way to affect injuriously the plant and animal life of the river as far down as Peoria Lake.

The animals of the river bottom are an especially important element in the life of the stream, because many of our most valuable fishes depend upon them for food; moreover, they indicate better than either chemical analyses or collections of the plankton the general and constant effect of pollution. A chemical analysis shows only what is to be found at the very spot and moment where and when the water sample analyzed was taken, and it may represent a local or temporary condition only; and the plankton, as it is constantly moving down-stream with the current, really shows what conditions are or have been above the point at which collections from it are made; but animals found together on the bottom are stationary, permanent residents of the stream, and sum up in the composition and numbers of the association the total effect of the conditions under which they are living and have lived for a considerable time.

As far down as Henry, 77 miles from the origin of the river at Dresden Heights, the bottom mud had a very foul odor in 1918 and con-

tained no living organism large enough to be seen by the naked eye except a great abundance of "slime-worms" (Tubificidae), characteristic of polluted water. At Lacon, 84 miles from Dresden Heights, the animals found were the same except for two specimens of molluska, one a small snail, (Musculium transversum), and the other a small bivalve, (Pisidium). At Chillicothe, 93 miles down-stream, the smell of the mud was not yet normal, and "slime-worms" were common, but the snails just mentioned were now abundant and a few specimens of a larger snail, (Campeloma subsolidum), were brought up by the dredge. At Peoria Narrows and Pekin, on the other hand, "slime-worms" were wanting and the water-snails, fresh-water sponges, crustaceans, and insect larvae taken were of kinds commonly found in the natural waters of an unpolluted river.

No signs of fishes were noticed at either Hennepin or Henry, and fishermen reported that none had been seen for a long time at either place.

STEPHEN A. FORBES,
Chief, State Natural History Survey.

In addition to the above report made by Mr. Forbes, the following additional report is received from R. E. Richardson:

I. THE CHANNEL PLANKTON

Methods.—Surface plankton samples dipped and strained through hard-pressed filter paper and No. 25 silk bolting-cloth were taken between August 28 and September 3 at seven stations in the river channel from Hennepin to Pekin, and microscopic examination of the living material was made on the ground the same day in all cases except the collections of the last date. While exact quantitative methods were not used either in collection or examination, the collections were of approximately uniform size, about 500 c. c. of water being condensed to about 1 c. c. through No. 575 hard-pressed paper, and about 20 liters condensed to about 2 c. c. through a No. 25 silk bolting-cloth filter. The amounts examined ran from 5 to 10 drops for the concentrated mixture, one drop at a time on plain slides. The method of rating and recording abundance was as follows: (1) Species seen not oftener than once in a slide were recorded as 1, meaning *present* in small numbers; (2) species seen more than once in each slide up to 4 or 5 times, were recorded +, meaning *common;* (3) species seen many times, usually 20 to 50 or more times in each slide, were recorded as ++, meaning *abundant.* As the filter paper samples furnished such sparse material for examination in a slide and added nothing of importance to the list of species made up from the silk samples, except in the case of two small green chlamydomonad protozoa, the records of abundance in the two accompanying tables may be said, (except in the case of these two species), to be made up from the silk collections.

Stations.—The list of stations and their distance below Chicago, (Robey Street) and above Grafton follows:

Station.	Miles above Grafton (0).	Miles below Robey Street (320.8).
Hennepin	208.0	112.8
Henry	196.0	124.8
Lacon	189.2	131.6
Chillicothe	180.5	140.3
Alfresco Park	167.4	153.4
Peoria Narrows	166.2	154.6
Pekin	153.0	167.8

The significance of the plankton data obtained can be best understood in comparison with our findings regarding the plankton of the upper river in the summers of 1910 and 1911.*

Sphaerotilus.—The single most important indication of progress of pollutional conditions down-stream since 1910 and 1911 is furnished by *Sphaerotilus natans.* This saprophyte disappeared from both channel and shore at or above Starved Rock in 1911, while on August 18-30, 1918, small clusters of it attached to very small particles of suspended matter were common at Hennepin, (which is 22.8 miles below Starved Rock), and were present as far south as Henry and Lacon, (34.8 and 41.6 miles below Starved Rock). Hennepin and Henry filaments were healthy and showed cell division in progress.

Blue-Green Algae.—The occurrence in abundance of isolated floating filaments of *Oscillatoria limosa* and other species of blue-green algae, probably pollutional, presents little if anything new as compared with conditions in 1911, and is probably of no great importance as an index of channel conditions on the spot, as these plants do not belong to the plankton, but are for the most part torn loose from shores, drift, and other points of lodgment in shallow water and may float long distances down stream.

Lake Michigan Diatoms.—Of two of the most important Lake Michigan diatoms (*Tabellaria flocculose* and *T. fenestrata*) I note that while in 1910 they recovered rapidly in numbers below Chillicothe, they now clearly show a moribund, faded-out condition and appearance at all stations, decreasing steadily down stream below Hennepin to the point of almost complete disappearance at Pekin.

Melosira.—*Melosira granulata* var. *spinosa,* another diatom entrant from Lake Michigan, which persisted alive through the worst sewage in 1910 and 1911 and showed uninterrupted increase then from Spring Valley or Hennepin southward, fails to increase now until it passes Chillicothe.

First Normal Plankton.—While Chillicothe marks now about as in 1910 and 1911, the point of first occurrence in goodly numbers of representatives of several other groups of clean-water organisms (other than diatoms, that is Chlorophyceas, green flagellate Protozoa, Rotifera), I note that a really normal plankton, as measured by variety of clean-water species and abundance of leading forms, is not now reached above Peoria Narrows; and that the plankton now present in the channel at the

* A very general account of the upper Illinois River plankton of July and August, 1911, is to be found in the bulletin of the Illinois State Laboratory of Natural History, Vol. IX, Art. X (June, 1913), pp. 496-500.

narrows is visibly influenced by contribution from Peoria Lake. (See table foot-note, on Peoria Narrows and vicinity).

Effect of Peoria Sewage.—Though the Peoria sewage now apparently results in marked decrease in dissolved oxygen between Peoria Narrows and Peoria, there is no perceptible unfavorable effect of it either on the composition or the abundance of the plankton at Pekin.

II. THE BOTTOM FAUNA

As in the case of the plankton we did not find a bottom fauna normal either in variety or abundance until we reached Peoria Narrows.

Hennepin.—At Hennepin the mud had a very foul odor and contained no macroscopic organisms except tubificid worms, which were very abundant.

Henry.—At Henry, above the dam, the odor of the mud was not noticeably better than at Hennepin, and nothing was found in it alive but the same worms. Bubbles were constantly rising from the bottom, and small sludge chunks were floating. The west bank was examined below the dam and no signs of living snails were seen.

Lacon.—At Lacon the mud contained tubificid worms, but we also found one living specimen of the sphaeriid snail, *Musculium transversum,* and one living Pisidium.

Chillicothe.—At Chillicothe the odor of the mud was not yet normal, and tubificid worms were still common. However, the snail *M. transversum* was abundant alive, and a few specimens were found of living *Campeloma subsolidum,* a species which we found to be one of the most tolerant snails in the upper river in 1912.

Peoria Narrows.—At Peoria Narrows the mud worked through the dredge box and could not be examined for odor. The fauna taken was normal to clean water, contained no Tubificidae, and was about the same in composition as collections taken there in 1912 and 1915. The principal organisms were:

Snails.	Pleurocera species.	Common.
	Goniobasis species.	Present.
Protozoa.	Freoricella species.	Abundant.
Sponges.	Spongilla.	Common.
Asellus species.		Common.
Hyalella knickerbockeri.		Common.
A red chironomid larva.		Present.

Pekin.—At Pekin also the bottom fauna was normal to clean water, and showed somewhat greater variety than at Peoria Narrows. The list is as follows:

Snails.	*Campeloma subsolidum.*
	Vivipara contectoides.
	Pleurocera species.
	Musculium transversum.
Mussels.	*Quadrula plicata.*
Sponges.	Trochospongilla.
Crustacea.	Asellus species.
	Hyalella knickerbockeri.
Insect larvae.	Hydropsyche species.
	Chironomid.
Leeches.	Undetermined.

R. E. Richardson,
Biologist, Natural History Survey.

SURFACE PLANKTON, ILLINOIS RIVER, CHANNEL, 1918

FILTER PAPER AND 25 SILK, QUALITATIVE

		Hennepin August 28.	Henry August 29.	Lacon August 30.	Chillicothe August 30.	Peoria Narrows and vicinity August 31-September 3.	Pekin August 31.
I.	Foul-water Species (indigenous)						
Schizophyceae	1. Sphaerotilus natans	†	3	1			
Cyanophyceae	2. Oscillatoria limosa, etc	††	††	††	††	†	1
Flagellata	3. Euglena viridis		1	1	†		1
Ciliata	4. Carchesium lachmanni	1			1		
	5. Epistylis plicatilis	1		1			
Rotifera	6. Rotifer actinurus	1					
II.	Tolerant Species (indigenous)						
Schizophyceae	7. Cladothrix dichotoma						1
Cyanophyceae	8. Anabaena spiroides		1	†	†		
Chlorophyceae	9. Scenedesmus quadricauda	1			†	1	1
	10. Acutus		1		1		
Ciliata	11. Coleps hirtus			1			
Rotifera	12. Rotifer tardus	†	†	†	†		1
III.	Tolerant Species (Survivals from L. Mich.)						
Flagellata	13. Chlamydomonas globosa ?	†	†	1	††		
	14. C. communis ?			1	1		
IV.	Clean-water Species (Survivals from L. Mich.)						
Bacillariaceae	15. Tabellaria flocculosa	††	†	†	1	1	1
	16. T. fenestrata	††	†	†	1	1	
	17. Fragellaria virescena	1	1	†	1		
	18. Melosira granulata spinosa	1	1	1	1	†	†
	19. Synedra acus	1	1	1	†	1	1
	20. Asterionella gracillima		1	1		1	
	21. Diatoma tenue			1			
Chlorophyceae	22. Pediastrum boryanum*			†	†	†	†
	23. Oocystis naegelli		1	1	1	1	1
	24. Dictyosphaerium sp				1		
V.	Clean-water Species (Indigenous)						
Cyanophyceae	25. Polycystis aeruginosa*		1				
	26. Microcystis species*		1	†	†		
Chlorophyceae	27. Rhaphidium polymorphum		1				
	28. Chloroganium species					1	
	29. Pediastrum pertusum*	1	1	1	†	†	†
	30. Closterium lunula						1
Flagellata	31. Trachelomonas hispida	1			1	1	1
	32. Euglena oxyuris			1			
	33. Phacus longicaudus					†	
	34. P. triqueter		1				1
	35. Pandorina morum			1	1		1
	36. Eudorina elegans				†		1
	37. Platydorina caudata		1	1	†		1
Rhizopoda	38. Difflugia globulosa						1
Ciliata	39. Codonella cratera			1	1	††	††
Rotifera	40. Asplouchna brightwellii				1		1
	41. Polyarthra platyptera		1	1	†	†	†
	42. Triarthra longiseta			1	1	†	1
	43. Ratulus tigris				1		
	44. Synchaeta pectinata					1	1
	45. Monostyla lunaris				1		
	46. Anuraea cochlearis					1	†
	47. A. aculeata		1			1	
	48. Brachionus angularis		1	1	1	†	†
	49. B. mollis				1	1	1
	50. B. bakeri brevispinosus		1		1	1	1
	51. B. bakeri melhelmi		1		1	1	1
	52. B. pala amphiceros				†		
Entomostraca	53. Cyclops sp. (adult)		1				1
	54. Nauplii		1		†	†	†
	55. Daphnia species				1		1
	56. Simo cephalus vetulus					1	1
	57. Bosmina longirostris			1		1	1
	58. Chydorus sphaericus			1			

† Silk plankton from the lake opposite AlFresco Park (about a mile above Peoria Narrows) showed a small shelled ciliate (*Codonella cratera*) and also Cyclops and copepod nauplii much more abundant than in the channel samples. Melosira was not noticeably more common at the lake than at the two channel stations.

* Classification of species under IV and V a little uncertain.

CHANNEL CANNOT BE ABANDONED

The Sanitary District channel cannot be abandoned. Its construction represents an expenditure of $30,000,000. It is a valuable asset to navigation and means an integral part in the development of the State.

Objectionable conditions of pollution must be overcome. To give a flow of water sufficient to overcome the existing pollution by dilution would exceed the capacity of the Sanitary District channel. To enlarge the channel to carry the flow that the population demands, and as fixed by the laws of the State, would entail flood and damage down State. This prohibits consideration of such a plan.

In March last, officers of this division were optimistic in the belief that the long standing controversy between the Government and Sanitary District in regard to the amount of water to be diverted from Lake Michigan could be satisfactorily adjudicated.

A conference was arranged with the Chief of Engineers of the War Department at Washington, attended by Charles H. Sergel, president of the Sanitary District, and the following trustees, namely, Lawley, Healey, Littler, Mueller, and Nance, and by William L. Sackett, superintendent of this division.

Satisfactory progress was made, admitted by Government engineers to be the first time in years it had been possible. General Lansing H. Beach, who had but recently assumed the duties of Chief of Engineers, urged representatives of the district and State to prepare at once data indicating actual conditions, the least diversion and flow from Lake Michigan that would handle sewage now and what would be necessary if sewage was first treated. The necessity for hurrying construction of sewage treatment plants was emphasized. The Government asked for specific information as to how soon the district could start on a definite construction plan and wanted assurance as to the date of completion of sewage plants to reduce the discharge of solids at least 50 per cent.

DANGERS ARE KNOWN

The dangers to Chicago and down State were realized and discussed. President Sergel and trustees of the Sanitary District present, strongly advocated adjudication of the differences with the Government and a policy that would protect down-State communities. It was suggested there should be curtailment of expenditures for everything except sewage treatment plants and such auxiliary work as would indicate good faith with the Government, the people of Chicago, and down State.

Investigation was at once started by the State with a view to a comprehensive analysis of the entire situation for report to the Chief of Engineers. The Sanitary District was expected to do likewise, so that a joint report might be submitted for Government consideration prior to May 1. Within three weeks, however, from the date of the conference with Government engineers at Washington, the then existing organiza-

tion of the Sanitary District was changed. President Sergel, who had been vetoing various proposals for expenditure of money for work other than that directly connected with sanitation or construction of treatment plants, was deposed, Trustee Healey being elected president in his place and funds of the district were later expended for various purposes in no way directly connected with construction of modern sewage treatment plants, and this division is not informed of any report submitted for the information of Government engineers as agreed upon and requested in the conference in March.

HOW CONDITIONS HAVE CHANGED

This division is indebted to Dr. Edward Bartow, chief of the Water Survey Division of the State, and Professor Stephen A. Forbes, chief of the Natural History Survey Division and R. E. Richardson, biologist, for a review of past and existing conditions. These gentlemen have been actively identified since 1912 in surveys and observations of the effect on plant and animal life of the Illinois River, including its fisheries, resulting from the various degrees of pollution by sewage discharged therein from the Sanitary District of Chicago and from the principal river towns. They have given studious consideration to the problem of dilution by water diverted from Lake Michigan and the flow required to remove or mitigate the most objectionable features of the present situation and of that certain to appear with a normal increase of population in Chicago and the river basin.

It was deemed inadvisable to duplicate the work or expense, and Professor Forbes was requested to give this division a supplemental report, indicating the least possible flow of water diverted from Lake Michigan deemed safe for purposes of sanitation by Chicago, desirable for the needs of navigation by the State, and that will save the Government millions in channeling, and not impose damage upon property owners down State or imperilling health of valley people.

The report submitted by Professor Forbes in April, 1920, follows:

REPORT OF PROFESSOR FORBES

We are all convinced that the present minimum rate of dilution of raw sewage fixed by the law of the State, which is a flow of 3.3 cubic feet of clean water per second for each thousand of the population whose sewage enters the river, is now and probably always has been inadequate to the maintenance throughout every year of proper conditions in the whole course of the Illinois, and that the evil consequences of this inadequacy are increasing rapidly with the growth of the contributing population and the multiplication in the Illinois basin of manufacturing establishments of various kinds which contribute to the pollution of the stream. We are also of the opinion that any amount of dilution which it is at all likely that we should be permitted to get by way of the Great Lakes, or which, if permitted, would be acceptable to those in-

terested in the use of the river for transportation purposes, would be inadequate unless the sewage admitted to the system is first so treated in whole or in great part as to remove the bulk of its putrescible and other injurious materials before its effluent is permitted to mingle with the river water. Until this is done, the choice lies between a *minimum* dilution, decidedly less than that used at present, which would retain the polluted waters in the upper part of the river until their organic contents had undergone putrefaction, so that the flow of the stream below Ottawa or LaSalle should be relatively innocuous; or the *maximum* dilution permissible, which would relieve the upper river somewhat, at least for a time, but would carry the putrefaction processes much farther downstream in a swifter current of deeper and cooler water, resulting sometimes in nuisance and injury, at least as far as Havana, and eventually, in all probability, to Beardstown or possibly to the river mouth.

The following is a summary of the principal facts on which these conclusions chiefly rest:

Before the opening of the sanitary canal of the Chicago district in January, 1900, the sewage of that great city was mainly decomposed in the Chicago River and in the Illinois and Michigan Canal, so that the upper Illinois River towns were little affected; but after the opening of the canal and the consequent reversal of current and increased flow of the Chicago River, the city was freed from nuisance at the expense of the upper Illinois. Nevertheless, even as late as the summer of 1911, when my staff first began to study the subject in that part of the stream, although at low water the river from Morris to the Marseilles dam was, in hot weather, very like a cess pool, being nearly devoid of oxygen, deserted by fishes, and destitute of the normal life of an Illinois stream, it began to recover at Ottawa, thirty-three miles from its origin, and was nearly normal as to the make-up of its plant and animal population at Hennepin, thirty-two miles farther down.

In 1918, on the other hand, polluted conditions very like those above Ottawa in 1911, had appeared 51 miles below Ottawa at Lacon where the bottom sediments of the river had a stinking odor, sewage worms were abundant in the sludge, which contained no clean water organisms, and the oxygen of the water was only about a tenth that of a normal stream and less than half that necessary to the life of our Illinois River fishes. In midsummer of this year of 1918 the tolerable conditions found at Hennepin seven years before were not met with above the narrows of Peoria Lake, 42 miles farther down. There has thus been a progression downward of pollutional conditions at an average rate of six or seven miles a year.

Up to 1918 the broad and shallow expanse of the river known as Peoria Lake had acted as a partial renovator of the polluted waters from above, but in 1919 this barrier was evidently broken through, as is shown by bottom conditions found in September of that year at the

middle of the river's length as compared with those of the same spot in July and August, four years previously. In these latter months of 1915, eight hauls of our apparatus for making quantitative collections from the river bottom gave us, in a short stretch of the river 145 miles below its origin, an average of 1,461 animals to the square yard, mostly water snails of half a dozen species; while three similar hauls made last September at the same place gave us an average of only 96 animals to the square yard, all a single kind of snail especially tolerant of pollutional conditions, no other animals of any kind being found. The bottom conditions here in 1919 closely resembled, in fact, those of 1918 at Chillicothe, 52 miles above the place at which these latest collections were made. Furthermore, with the disappearance of the animal life of the bottom, upon which the river fishes largely depend for food, the number of the fishes themselves has fallen off so far that fishing operations were generally abandoned last summer in the middle of the season at Havana, between which place and Liverpool the observations above described were made.

Ratio of Dilution Unchanged.

It is important to note that during this period of increasing and progressive pollution, the ratio of dilution to the population of the Sanitary District has remained, according to the best available information, substantially constant at the legal figure of 3.3 second feet per thousand, averaging, for example, 3.51 second feet in July and August, 1911, and 3.54 in 1919-1920. It is estimated that the population of Chicago has increased during this decade about half a million, and the numbers of cattle and hogs slaughtered in the stockyards have risen about 25 per cent and 32 per cent respectively. As the volume of the city wastes has been thus increased, the volume of water admitted from Lake Michigan has been enlarged proportionally, with the result that the current of the river has been speeded up and a larger load of organic matter has been carried farther down-stream than before. A contributing cause of these changes has been the construction of new levees along the river for the reclamation of bottom lands. By a confinement of the river to narrower limits at medium stages and above, the strength of the current is increased, the suspended organic matter is carried farther down-stream before it settles, and the bottom sludges are moved along to greater distances in times of flood.

With respect to the contrasted effects of what we may call the cesspool method of management and the maximum dilution method, we have fortunately a perfect illustration in the conditions in the Peoria section of the river in 1899 as compared with those in 1911—the first period coming just before the river flow had been reinforced by the sanitary canal, and the last eleven years after the canal was opened. In August, 1899, the waters of the Illinois from LaSalle to Peoria were heavily saturated with oxygen containing, in fact, more than three times the

percentage that the same waters contained in August, 1911; but on receipt of the Peoria sewage they suddenly lost this advantage, the river at Wesley two miles below, containing less than a fourth of the oxygen which it contained at Averyville just above the city, and only about two-thirds as much as in August, 1911. It reacted quickly, however, and was again supersaturated only 16 miles below Peoria.

The contrast in 1911 was striking and instructive. Beginning at LaSalle with 40 per cent of the oxygen ratios present in 1899, the cooler, larger current passed Peoria with no indication whatever that an additional sewage load had been received at that point; and at Copperas Creek dam, 21 miles farther down, it contained less than half the oxygen of 1899. The relatively shallow, sluggish, clean-water current of the midsummer before the opening of the canal digested its sewage intakes and regained its normal state of oxygenation within short distances; but the deeper, cooler, stronger current of eleven years later disposed of its overload slowly, imperfectly, and over long distances, reaching Peoria in a stage of pollution to which the sewage of that town added too small a percentage to be noticeable.

A Vexing Problem.

Turning to the problem of the amount of dilution likely to be most useful under the circumstances now existing, I find the subject vexed with complexities and bristling with difficulties. A choice must evidently be made between the two alternatives already mentioned—on the one hand an upper river badly polluted, at least in hot weather, low-water stages, but with the general course of the stream always in at least a fair condition; or, on the other hand, a lesser degree of pollution, extended indefinitely far down stream.

A choice of the first alternative would limit the more injurious pollution to the most scenic and frequently visited part of the river, but to that of the least economic importance, the fisheries above LaSalle having never been valuable, and it would involve a sacrifice of the interests of a part of the inhabitants of the valley for the benefit of the remainder. Furthermore, if we were to return, let us say, to the 7,000 second feet of water taken from Lake Michigan in the midsummer of 1911 in place of the 8,500 of last year, we should be applying the former dilution to a sewage load 20 per cent heavier than that of the earlier period, and the area of pollution would be correspondingly prolonged down-stream. It further seems unlikely that the polluted waters could be permanently penned up so that they would not be swept downward to do extensive damage in times of relatively high water in the summer season. Only experience (or experiment) can settle some of these points.

A choice of the second alternative would mean a material increase of dilution at certain times beyond the present rate of 3.3 second feet to the thousand of population, and here we meet at once with three difficul-

ties; there is a limit beyond which the Federal and Canadian governments will not allow us to go because of the effect on the level of the Great Lakes; there is a limit also beyond which the use of the river for transportation would be hampered or endangered; and any substantial increase of river levels might involve the Sanitary District in heavy charges for the overflow of agricultural lands and render the protection of reclaimed areas by levees more expensive. These difficulties might be met in part, however, by varying the intake from the lake from time to time, according to the river levels, taking a maximum amount when the river is lowest and relatively little when it is in flood—substituting, in fact, for the present requirement of a minimum *rate of dilution,* whatever the stage of the river may be, the maintenance of a *minimum flow of the stream* at some one point (as at Hennepin or Peoria) this minimum being fixed at a rate sufficient to maintain the necessary clearage flow in Chicago River and the sanitary canal and to prevent nuisance conditions at the important town of Joliet. If to this is added a maximum limit of appropriation from Lake Michigan, to be determined by lake levels and the requirements of river transportation, we shall have gone, in my opinion, as far towards an amelioration of the evils of the situation as is possible under present conditions.

It will be seen that the choice between the alternatives which I have presented is really a choice of evils, such as ought not to be forced upon guardians of the public welfare; and that the only escape from it is in the direction of a preliminary treatment of the raw sewage sufficient to make its effluent practically unobjectionable. The first and most obvious step in this course would naturally be a treatment of the packing-house sewage and of the other trade wastes which are now sent into the canal and the Illinois River in violation of the present law of the State; and the second step would be a treatment of the general sewage of Chicago and the river towns which now drain into the river, directly or indirectly.

Waterway Dams May Help.

There is, however, a possible minor source of prospective relief which should be mentioned, although I do not know of any way in which its value can be estimated; and this is the effect of proposed additional dams in the upper river between Dresden Heights and Starved Rock. We found in 1911 that the plunge in midsummer of the heavily polluted water over the Marseilles dam, whose fall was then about 10 feet, had the effect so to aerate the water as to multiply the dissolved oxygen ratio by three. If this dam is raised 3 feet, as I believe is the present intention, and three other dams are built in this part of the stream, this effect will, of course, be much increased, and perhaps multiplied several times.

Assuming, now, that the best that can be aimed at until trade wastes are largely eliminated and general sewage treatment is begun, is a condition of the river, or at least the major and better part of it, such that

it shall not be at any time offensive to sight or smell; and that its fishes, mussels, and other valuable animals, and the plants and animals of their food shall be able to live, thrive, and multiply in normal numbers, the final question arises: what ratios of feasible dilution will best serve these ends?

Dilution Ratio Must Increase.

At this point, after an organization and careful study of all the data available to us, both from published statements and from our own observations, I am compelled to conclude that the biologist and the chemist must give way to the engineer. It seems proper to say, however, that in our judgment the maximum dilution permitted should be made as high and the minimum dilution required should be placed as low as the limiting conditions which I have specified will permit; that within this range practice should be varied as experience may indicate; and that preliminary treatment, first of trade wastes and then of general city sewage, should be pushed as rapidly and carried as far as possible.

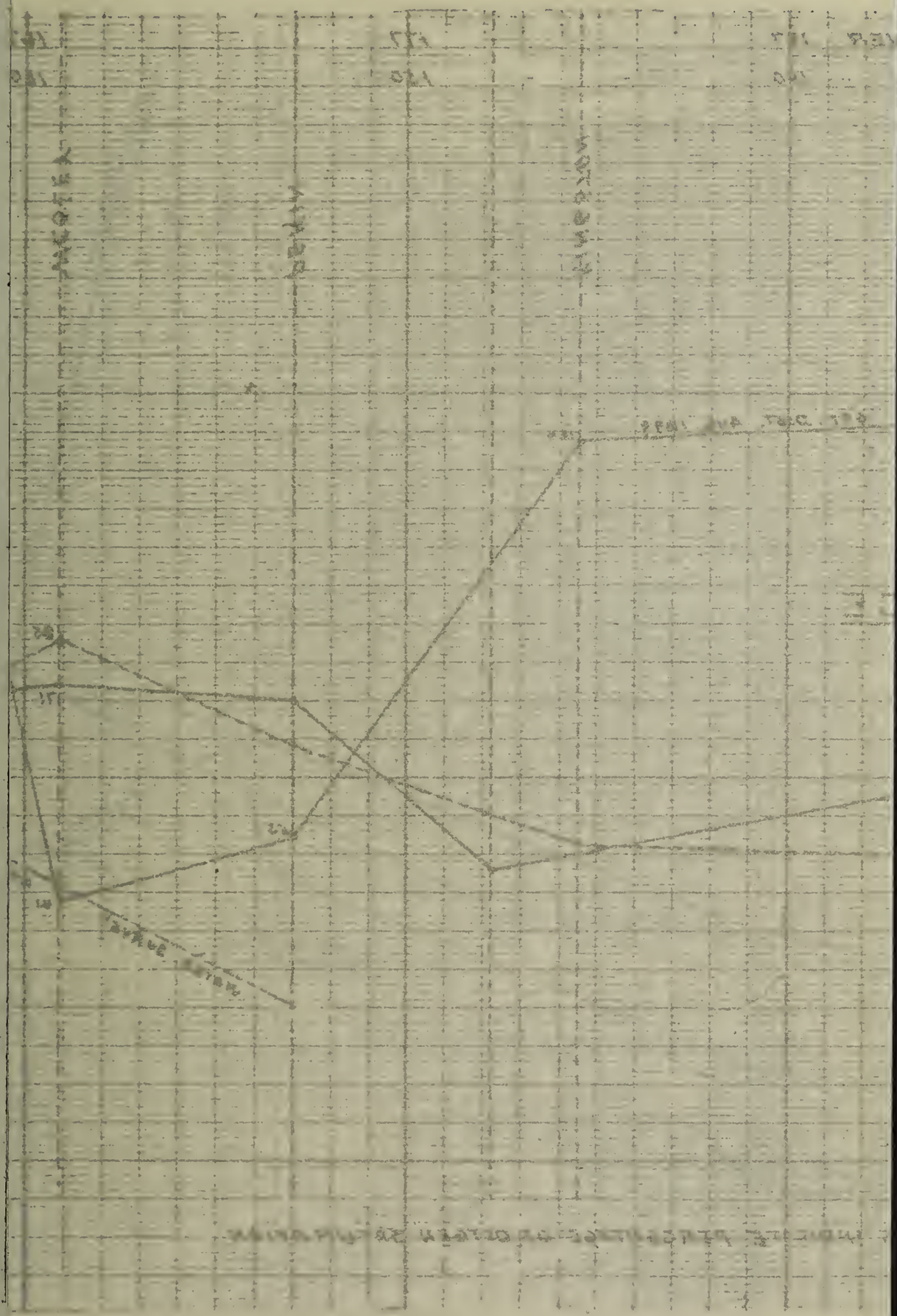
When we remember that the city of London was treating its sewage and had been doing so, I believe, for some time when our sanitary canal was opened in 1890; that an English Royal Commission on Sewage Disposal, after years of investigation, reached the conclusion that unscreened sewage should not be permitted to flow into any stream; and that it fixed the rate of dilution of screened sewage at more than seven times the legal dilution rate for crude sewage in Illinois, we see how far short we fall of what may be called standard methods of management.

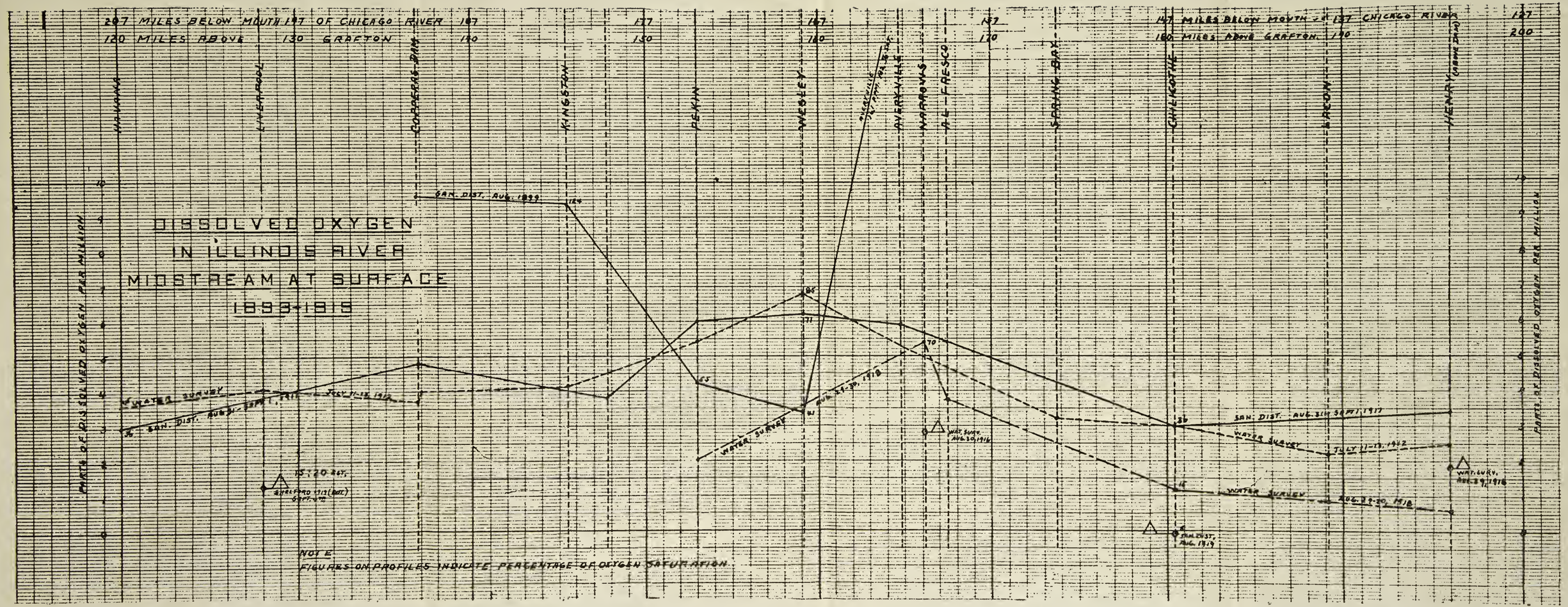
I have had prepared a considerable number of tables and diagrams supporting and illustrating the statements of this report which follow:

POPULATION AND FLOW (CHICAGO AND LOCKPORT)

	1896-1899	1911	1919-1920	1930	1940
Population (Chicago)	1,542,000 (Mean, 3 years, Palmer)	2,185,283 (Census, 1910)	2,881,000 (Census, 1920)	3,500,000 (Estimate Wisner)	4,100,000 (Estimate Wisner)
On I. and M. Canal (85%)	1,310,700	----------	----------	----------	----------
Deduct Cal.-Sag	----------	—200,000* (Soper, etc., 1914)	250,000 (Est.)	Figured as open	Figured as open
On Sanitary Canal	----------	2,000,000 (About)	2,631,000 (About)	----------	----------
Stock Yards equivalent	750,000 (About)	769,230**	1,000,000 (Pearse)	1,000,000+	1,000,000+
Floating population	No estimate	250,000 (Estimated)	+300,000***	— +300,000	— +300,000
Approx. total connected	2,060,700	3,019,230	3,931,000+	4,800,000	5,400,000+
Minimum discharge at 3.3 to carry total	6,798 Sec. Ft.	9,962	12,972	15,840	17,820
Actual discharge at Lockport	600-1,000 Sec. Ft.	6,454 yr. av.; 7,036 Av. July-Aug.	8,500	?	?

* "Less than 200,000." Soper, Martin, Watson, 1914.
** Figured on basis of packing statistics and Pearse estimate, 1919.
*** Estimate of City Wastes Commission, 1914.




DISSOLVED OXYGEN
IN ILLINOIS RIVER
MIDSTREAM AT SURFACE
1893-1919
207 MILES BELOW MOUTH OF CHICAGO RIVER
120 MILES ABOVE GRAFTON
147 MILES BELOW MOUTH OF CHICAGO RIVER
180 MILES ABOVE GRAFTON
HAVANA
LIVERPOOL
COPPERAS DAM
KINGSTON
PEKIN
WESLEY
AVERYVILLE
NARROWS
AL FRESCO
SPRING BAY
CHILICOTHE
LACON
HENRY
PARTS OF DISSOLVED OXYGEN PER MILLION
SAN. DIST. AUG. 1899
WATER SURVEY
SAN. DIST. AUG. 31-SEPT. 1, 1917
JULY 11-13, 1912
AUG. 29-30, 1918
WAT. SURV. AUG. 30, 1916
SAN. DIST. AUG. 31-SEPT. 1, 1917
JULY 11-13, 1912
AUG. 29-30, 1918
SAN. DIST. AUG. 1919
WAT. SURV. AUG. 29, 1916
15:20 EST.
SHELFORD 1913 (BUT.)
NOTE
FIGURES ON PROFILES INDICATE PERCENTAGE OF OXYGEN SATURATION

SANITARY DISTRICT CANAL SEWAGE TREATMENT—APPROXIMATE TIME REQUIRED FOR 25 PER CENT AND 50 PER CENT REDUCTION OF LOAD† (CONSTRUCTION FOR 300,000 TO 600,000 PER YEAR)

		I	II	III	IV
Construction yearly for		600,000	500,000	400,000	300,000
Less population increase		100,000	100,000	100,000	100,000
Net reduction load yearly		500,000	400,000	300,000	200,000
Total number* on Sanitary Canal, years ending December 31.					
	1919	3,931,000	3,931,000	3,931,000	3,931,000
1	1920	3,431,000	3,531,000	3,631,000	3,731,000
2	1921	2,931,000	25% 3,131,000	3,331,000	3,531,000
3	1922	2,431,000	2,731,000	3,031,000	3,331,000
4	1923	1,931,000	50% 2,331,000	2,731,000	25% 3,131,000
5	1924		1,931,000	2,431,000	2,931,000
6	1925			2,131,000	2,731,000
7	1926			1,831,000	2,531,000
8	1927				50% 2,331,000
9	1928				2,131,000
10	1929				1,931,000

* Stock yards equivalent, 1919 = 1,000,000 persons.
† 25-30 per cent reduction takes us back to approximate condition of 1911 (population 2,700,000—3,000,000).

DISSOLVED OXYGEN, ILLINOIS RIVER CHANNEL—SURFACE SAMPLE (EXCEPT *)

	Miles below mouth Chicago River.	Sanitary Dist. Aug. 1899		Sanitary Dist. Aug.-Sept., 1911.		Water Survey July, 1912.		Water Survey Aug.-Sept. 1918.		Miscellaneous Aug-Sept. 1919.	
		P.P.M.	% Sat.	P.P.M.	% Sat.	P.P.M.	% Sat.	P.P.M.	% Sat.	P.P.M.	% Sat.
Henry, above dam.	131.0	16.6	210	3.4	39	2.5	28	0.6	8		
Lacon	137.8					2.2 (2)	27	0.9	12		
Chillicothe	146.5			3.0	36 ca	3.0	36	1.2	15	0.4 (nhs Aug. 1919)	5 ca
Spring Bay	153.2					3.2	38				
Alfresco Park	159.6							3.8	49		
Narrows	160.8							5.4	70		
Averyville	162.3	16.1	182	5.9	68	5.3	64				
Wesley	167.8	3.4	41	6.2	71	6.8 (2)	85				
Pekin	174.0	4.2	55	6.0	70 ca	5.4	67	2.1	27		
Kingston	181.5	9.4	124			4.1 (3)					
Copperas Dam, above	190.2	9.6	124	4.8	56	4.0	47				
Copperas Dam, below	190.2			4.8	56	3.7	45				
Liverpoll	199.0					4.1 (2)				1.3* bott. sample (nhs Sept. 1919)	20 25 Est. Surf
Havana	207.0			3.0	36 ca	3.6	45				

PACKING STATISTICS (YEARS ENDING MARCH)

	Cattle.	Hogs.
Av. 3 years, 1890-93	2,447,693	5,217,850
Av. 3 years, 1896-99	1,697,369	6,910,511
Av. 3 years, 1909-12	1,722,432	5,416,242
Av. 3 years, 1915-18	2,149,117	7,099,749

STEPHEN A. FORBES,
Chief Division of Natural History Survey.

COMMENT BY DIVISION ON FORBES REPORT

In the Forbes report herewith reference is made to an average diversion from Lake Michigan and flow of 8,500 c. f. s. last year. This is inadequate for dilution of the present sewage load discharged, or as required by State law per thousand of population.

The records of this department show a somewhat higher average diversion and flow, approximately 10,000 c. f. s. the flow fluctuating from about 6,000 c. f. s. to above 14,000 c. f. s.

This division believes that with all the sewage treatment plants that can be provided for Chicago a 10,000 c. f. s. flow will be required for dilution—at least for many years—and that it can never be materially reduced. A flow of 10,000 c. f. s. will not interfere with river navigation; a greater flow will. A 10,000 c. f. s. flow will not raise water levels in the Illinois River or overflow or add to property damage, which resulted when the first diversion of water by the Sanitary District was sent down, and in no way change conditions in this particular as they have existed the past fifteen years.

The following tabulation by engineers of this division is compiled on the basis of a population in the Sanitary District of Chicago in 1920 of 3,000,000, and that the stockyard waste equals an additional population of one million. The figures are further based on an estimated growth of population of 100,000 per year, and that sewage treatment plants to care for from 200,000 to 600,000 population will be constructed and put into operation each year.

The tabulation indicates that by construction of sewage treatment plants each year that will take care of 300,000 population, it will take until the end of 1928 to bring the sewage load within a limit that might be unobjectionably diluted by 10,000 c. f. s., and at least until 1933 to reduce the present amount of untreated sewage by 50 per cent. Should construction be carried on at the more probable rate of 200,000 population per year, it will take until the end of 1934 to reach the limit of dilution and until the end of 1944 to reduce the untreated sewage by 50 per cent.

PUBLIC INTERESTS PROTECTED IN WOLF AND HYDE LAKES

July 1, 1917, when the Superintendent of the Division of Waterways assumed the duties of that office, a case was pending involving the

question of encroachments upon Wolf and Hyde Lakes and title to the beds thereof.

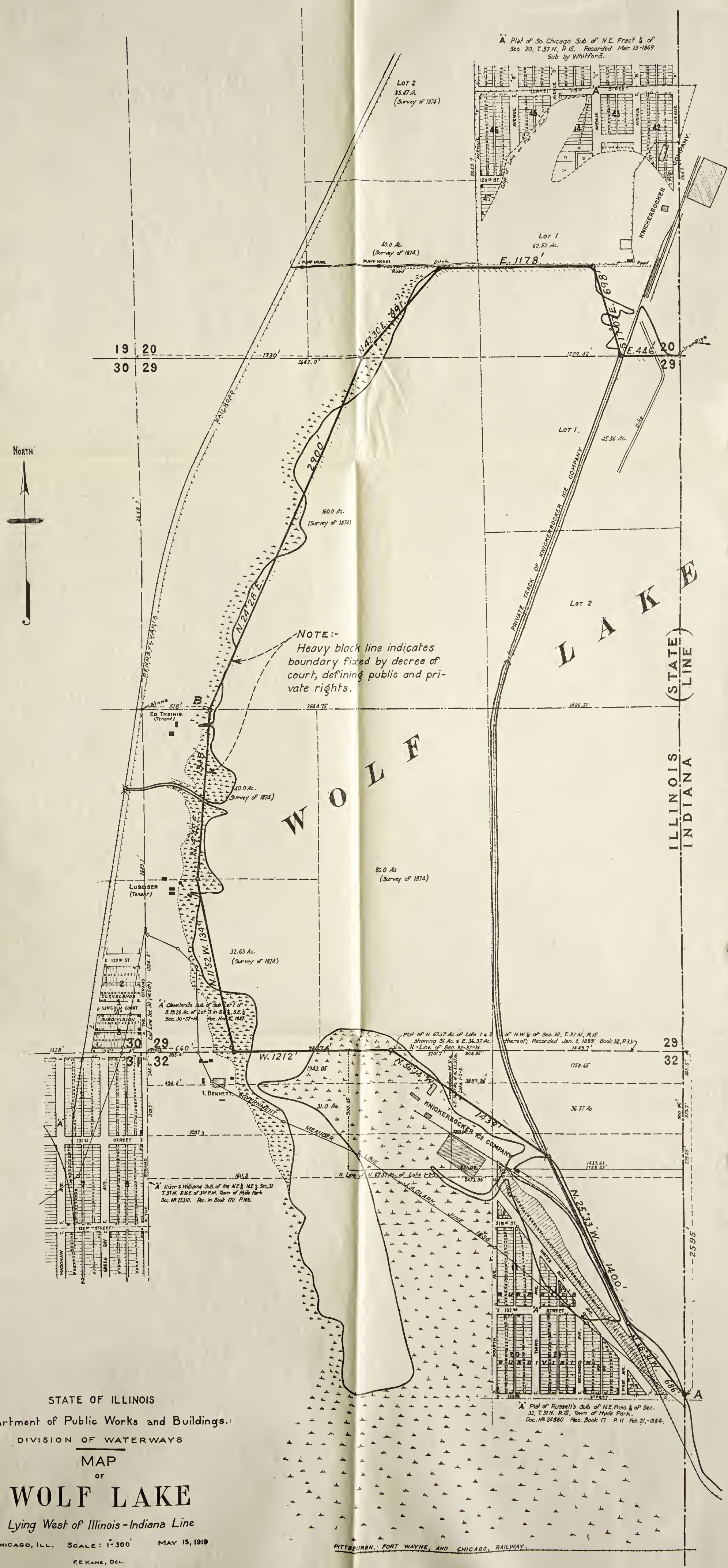
The proceeding originated by an information filed April 3, 1916, in behalf of the State by the Attorney General against Charles B. Shedd, John H. Hardin, Adolphus C. Bartlett and others, alleging that said lakes were and always had been navigable in fact and that by reason

SANITARY DISTRICT CANAL SEWAGE TREATMENT—TIME REQUIRED FOR 25 PER CENT AND 50 PER CENT LOAD REDUCTION ASSUMING CONSTRUCTIONS FOR 200,000 TO 600,000 POPULATION PER YEAR

YEAR	POPULATION (EST.)	600,000 CONSTRUCTION PER YEAR	500,000 CONSTRUCTION PER YEAR	400,000 CONSTRUCTION PER YEAR	300,000 CONSTRUCTION PER YEAR	200,000 CONSTRUCTION PER YEAR
1920	4,000,000	4,000,000	4,000,000	4,000,000	4,000,000	4,000,000
1921	4,100,000	4,100,000	4,100,000	4,100,000	4,100,000	4,100,000
1922	4,200,000	4,200,000	4,200,000	4,200,000	4,200,000	4,200,000
1923	4,300,000	3,700,000	3,800,000	3,900,000	4,000,000	4,100,000
1924	4,400,000	3,200,000	3,400,000	3,600,000	3,800,000	4,000,000
1925	4,500,000	2,700,000	3,000,000	3,300,000	3,600,000	3,900,000
1926	4,600,000	2,200,000	25% 2,600,000	3,000,000	3,400,000	3,800,000
1927	4,700,000	50% 1,700,000	2,200,000	2,700,000	3,200,000	3,700,000
1928	4,800,000		1,800,000	2,400,000	3,000,000	3,600,000
1929	4,900,000			2,100,000	25% 2,800,000	3,500,000
1930	5,000,000			1,800,000	2,600,000	3,400,000
1931	5,100,000				2,400,000	3,300,000
1932	5,200,000				2,200,000	3,200,000
1933	5,300,000				2,000,000	3,100,000
1934	5,400,000				50%	3,000,000
1935	5,500,000					25% 2,900,000
1936	5,600,000					2,800,000
1937	5,700,000					2,700,000
1938	5,800,000					2,600,000
1939	5,900,000					2,500,000
1940	6,000,000					2,400,000
1941	6,100,000					2,300,000
1942	6,200,000					2,200,000
1943	6,300,000					2,100,000
1944	6,400,000				50%	2,000,000

thereof title to the beds thereof was in the State of Illinois in trust for all the people of the State.

The information further alleged in behalf of the State that the waters of said lakes "have receded to some extent from the original meander line or actual shore line, because artificial means have been employed by various parties, and particularly various of the defendants



STATE OF ILLINOIS

Department of Public Works and Buildings.

DIVISION OF WATERWAYS

MAP

OF

WOLF LAKE

Lying West of Illinois-Indiana Line

CHICAGO, ILL. SCALE: 1" = 300' MAY 15, 1919

F. E. KANE, DEL.

and their grantors in title, to lower the waters of said lakes as they naturally were or would be if left free from disturbing causes, and raised the bed of said lakes by filling in the waters thereof by erecting various structures thereon, and by various other means but for which the waters of said lakes would not have receded from said original meander line but would have remained as they were at the time of said original survey; that for more than sixty years said lake or lakes have been used for the purpose of navigation by various small water craft, for fishing by large numbers of people of this State, and such use, until within the past few years, has been entirely free and unobstructed. The defendants claim interests in various lands contiguous to said lakes, and also claim title to or some interest in the bed of said lakes as private property, and have set up a claim of ownership of the land forming the bed of said lakes and are endeavoring to deprive the people of this State of the free and unobstructed access to said lakes and use thereof for purposes of navigation, fishing, and other lawful purposes."

The defendants filed separate answers, all in substance denying the State had any rights in and to the beds of said lakes as against the defendants.

Upon a hearing before Judge Walker in the Cook County Circuit Court, the State offered no evidence in support of its original bill of complaint. The court ordered that the bill be dismissed. The State then contended that the evidence offered by the complainants in support of their respective bills of complaint was too uncertain and indefinite to justify the court in entering any decree based thereon. The court upheld this contention of the State and directed that a survey be made by competent surveyors, one to be selected by the State and the other by the cross complainants; that these surveyors go upon the land and make a complete survey together with a proper plat showing such survey, and that a decree would be entered fixing the rights of the respective parties based upon such actual survey.

In compliance with this order of the court, in May, 1919, J. B. Fountain, engineer of this division, representing the State, and Isham Randolph, acting in behalf of the cross complainants, made a survey of the entire shore line of Wolf and Hyde Lakes which was submitted to the court and a decree based thereon entered upholding the contention of the State to title in the beds of these lakes, and established in this manner the exact location of the dividing line separating private property from public waters of the State.

A map locating the survey upon which the decree of the court is based is attached as a part of this report.

STATE BOUNDARY LINE FIXED

At the request of the Division of Fish and Game, engineers of this division surveyed and established by suitable markers and buoys the line between Illinois and Indiana.

There had been numerous complaints of arrests by Indiana petty officials of hunters and fishermen claimed to be within the boundaries of Indiana, while in fact within Illinois. Officials interested were charged with operating with a common understanding resulting in fines of from $15 to $25 in each case, and "splitting" the amount. Since the survey fixing the line this practice has been stopped and Illinois citizens are no longer troubled or molested.

INVESTIGATION OF THE DISPOSAL OF FLOOD WATERS FROM BAY CREEK INTO CACHE RIVER VALLEY

In December, 1919, Senator W. A. Spence, of Massac County, fifty-first district, joined with S. B. Kerr, secretary of the Cache River Drainage District, in a request to this division to investigate and report on a project for caring for the overflows of Bay Creek into the Cache River valley. A drainage district was partially completed at considerable expense to the people of the affected territory. A controversy arose as to the best plan to follow.

Request was also made to the Bureau of Public Roads, U. S. Department of Agriculture, to investigate and report upon plans for the improvement of drainage conditions in the Cache River District. The Government assigned to this work S. H. McCrory, chief of drainage investigations, and D. L. Yarnell, senior drainage engineer.

The Government and State engineers cooperated in the work, the former reporting on conditions in the Cache River District alone, and the State as to disposal of that part of the flood waters of Bay Creek reaching the Cache River valley. This division is indebted to the United States engineers above for the map used in connection with this report, to S. B. Kerr, secretary, and the commissioners of the Cache River District and to W. N. Moyer and J. T. Corlis, engineers of that district for assistance rendered W. G. Potter, drainage engineer of this division.

The request of the Cache River District to this division was for a report "on the best way to dispose of the flood waters of Bay Creek considered from an impartial and disinterested engineering viewpoint without regard to legal questions involved."

Mr. Potter's report follows:

REPORT OF W. G. POTTER

General Description.

Cache River is a stream on the southern slope of the Ozark hills in southern Illinois and flowing into the Ohio River between Cairo and Mound City. Its basin comprises much of the lands of Massac, Union, Johnson, Pulaski, and Pope Counties.

Its chief characteristic in the line of drainage is the quick run-off of its waters from the sources of its various tributaries in the hills till those streams reach the bottom lands, followed by much slower run-off in those bottom lands, due to the very slight fall from there to the Ohio.

The consequence has been that periodically, sometimes even two or three times a year, the bottom lands are flooded and crops are destroyed. To avoid this and to make the lands usable for farm purposes, the Cache

I. C. R. R. Bridge over Bay Creek. Bay Creek relief channel may be seen back of bridge abutment.

Upstream from I. C. Bridge. Bay Creek relief cut to one-half width on left. Bay Creek channel on right.

River Drainage District was organized. Various ditches were constructed, some of which were miles in length, the river itself was straightened and cleaned of debris, drift, etc., and levees were built.

Also a seven mile cut-off channel was constructed at a cost of nearly $250,000 from near the mid-point of the Cache to the Ohio, designed to take all of the drainage from the eastern part of the Cache valley direct to the Ohio.

Bay Creek is a smaller stream arising in the hills of Johnson and Pope Counties, flowing rapidly south in its upper reaches, but, like the Cache, slowing up on reaching the bottoms. South of Reevesville the Bay turns towards the east, and following a very winding course finally reaches the Ohio west of Golconda. For a distance of about two and one-half miles near Reevesville, Bay Creek passes through a low, flat bottom, which also contains the eastern ditches draining to the Cache, and there is practically no divide between them. The result is that whenever the waters of the Bay overflow its west bank, the excess goes down through the Cache River ditches and increases the flood waters already accumulated there.

Previous Reports.

Reports have been made previously on the same problem by J. McEathern, drainage engineer of the U. S. Department of Agriculture, W. N. Moyer, of Mound City, advisory engineer to the Cache District, and J. T. Corlis, local engineer of the Cache District. All agree in favoring the construction of a levee dividing the waters of the Bay and Cache and compelling all Bay Creek flood waters to remain in Bay Creek.

Following out this plan, construction of a levee was begun. In building this levee the plan was to dig a relief channel along the west side of the Bay and use the excavated material to make the levee. Completion of this work was stopped by court proceedings and a permanent injunction was obtained against its completion on the ground that flood waters have naturally passed from the Bay channel to the Cache valley for ages heretofore, thus making it a natural flood waterway for that water. Appeal has been taken from that decision. (Since the completion of this report the Illinois Supreme Court has reversed the decision of the lower court and dissolved the injunction.)

Bay Creek Watershed.

Bay Creek watershed, above and including its main tributary, Sugar Creek, contains an area of over one hundred square miles. Much of this area is hilly and covered with forests, and also considerable of it consists of flatbottoms often covered with water.

The point of contact of Bay Creek and Cache valley begins about a mile north of Reevesville, called Kidnocher Cut, and stretches to the south for about two and one-half miles. The bay along here is from 60 to 90 feet wide between banks and about 10 feet deep. It is crossed by the Golconda branch of the Illinois Central Railroad on a steel truss, and by a steel highway bridge. At the lower end of this part of the bay, beginning about at the line between Massac and Pope Counties, near the

center of Section 6, T. 14, R. 5, a relief channel has been constructed by the Bay Bottoms Drainage District which is about seven miles long. This relief channel was originally 18 feet wide (bottom width) at the upper end and 24 feet at the lower end, and cuts off about seven miles from the old channel, thus increasing the fall and velocity materially. It is from Kidnocher Cut to this relief channel that the proposed channel and levee were to be built. In other words, it was intended to extend the Bay Creek relief to Kidnocher Cut and use the dirt for a levee on the west side thereof.

Rainfall and Run-Off.

There are no available records of rainfall and no stream measurements in the valley of the Bay, and the amount of rainfall and its run-off must necessarily be very roughly estimated from the nearest available rainfall stations. It is strongly recommended that the Drainage District establish gauges at the I. C. bridge over the Bay and Sugar Creek, and that daily readings be taken on them, especially in times of high water.

TABULATION OF EXCESSIVE RAINFALLS.

Storm period.	Depth in inches.	Cairo in 43 years number.	Paducah in 43 years number of storms.	New Burnside in 10 years number.
1 day	2 inch	18	24	20
	3 "	9	7	7
	4 "	5	5	3
	5 "	1	2	2
	6 "	0	0	1
	Maximum	5.69 " (1910)	5.08 " (1901)	6.21 " (1911)
2 days	3 inch	13	27	15
	4 "	9	12	3
	5 "	2	5	3
	6 "	1	1	2
	7 "	1	1	2
	8 "	1	0	1
	Maximum	9.24 " (1910)	7.00 " (1910)	10.72 " (1910)
3 days	4 inch	12	19	8
	5 "	4	12	3
	6 "	1	3	3
	7 "	1	1	3
	8 "	1	1	1
	Maximum	10.53 " (1910)	8.90 " (1910)	12.09 " (1910)
4 days	5 inch	7	16	4
	6 "	2	9	4
	7 "	1	4	3
	8 "	1	1	1
	Maximum	10.95 " (1910)	9.02 " (1910)	12.20 " (1910)
5 days	5 inch	9	19	4
	6 "	5	14	4
	7 "	2	7	3
	8 "	1	3	1
	9 "	1	1	1
	Maximum	10.95 " (1910)	9.02 " (1910)	12.20 " (1910)
6 days	6 inch	7	17	4
	7 "	6	12	3
	8 "	2	6	2
	9 "	1	2	1
	Maximum	10.95 " (1910)	10.18 " (1880)	12.20 " (1910)

Having no statistics directly giving us the information wanted, we will use others near at hand. For these we have selected Cairo, southwest of the region desired, Paducah, southeast of the same, and New

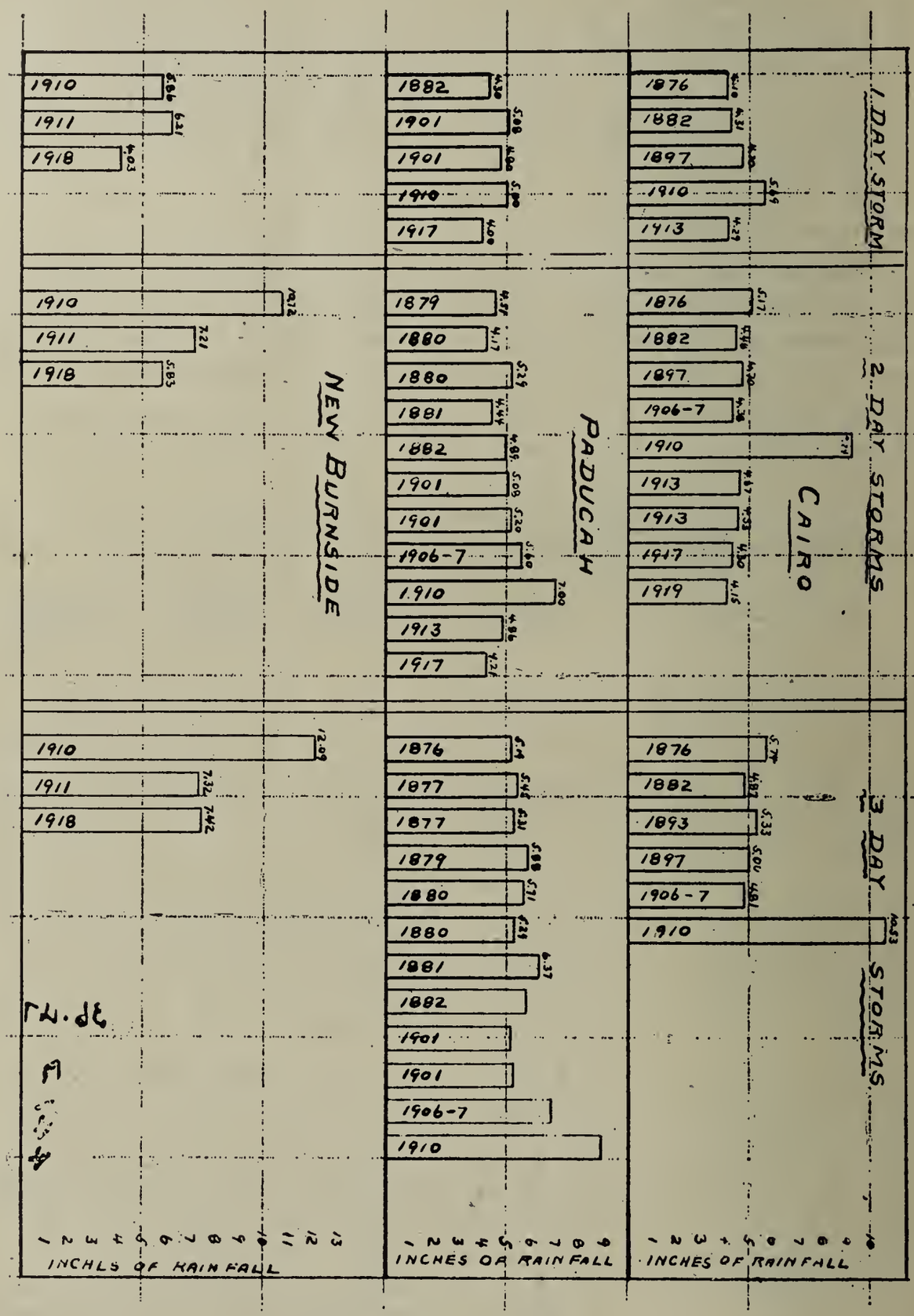


CHART OF EXCESSIVE RAINFALLS.

Burnside just over the divide north. The first two are taken from records of 43 years, and the last for a ten year period beginning with 1910. From these we get the excessive rainfalls shown on Inset 1

graphically, and on Tabulation 1. Summarizing these figures we find the following storms of excessive rainfall:

One day storms:

At Cairo, 5 storms of 4″ or over in 43 years.

At Paducah, 5 storms of 4″ or over in 43 years.

At New Burnside, 3 storms of 4″ or over in 10 years.

Two day storms:

At Cairo, 1 storm of 6″ or over (9.24″) in 43 years.

At Paducah, 1 storm of 6″ or over (7.00″) in 43 years.

At New Burnside, 2 storms of 6″ or over, (max. 10.72″) in 10 years.

Three day storms:

At Cairo, 1 storm of 6″ or over (10.53″) in 43 years.

At Paducah, 3 storms of 6″ or over (max. 8.90″) in 43 years.

At New Burnside, 3 storms of 6″ or over (max. 12.09″) in 10 years.

The two and three day maxima of all and the one day maximum at Cairo were of the storm period in 1910, causing the highest water on record in that region, excepting for the back water flood caused by the high water in the Ohio River in 1913. From these figures we see that one day storms of over 4″ and two and three day storms of over 6″ downfall are of very rare occurrence.

From the studies of the Miami Conservancy in their Storm Rainfall of Eastern United States we derive the following information for the region covered by this report:

Once in 15 years we are likely to have a storm of

4.4 inches in 1 day.
6.0 inches in 2 days.
6.4 inches in 3 days.
6.8 inches in 4 days.

Once in 25 years we are likely to have a storm of

5.25 inches in 1 day.
6.6 inches in 2 days.
7.3 inches in 3 days.
7.5 inches in 4 days.

Once in 50 years

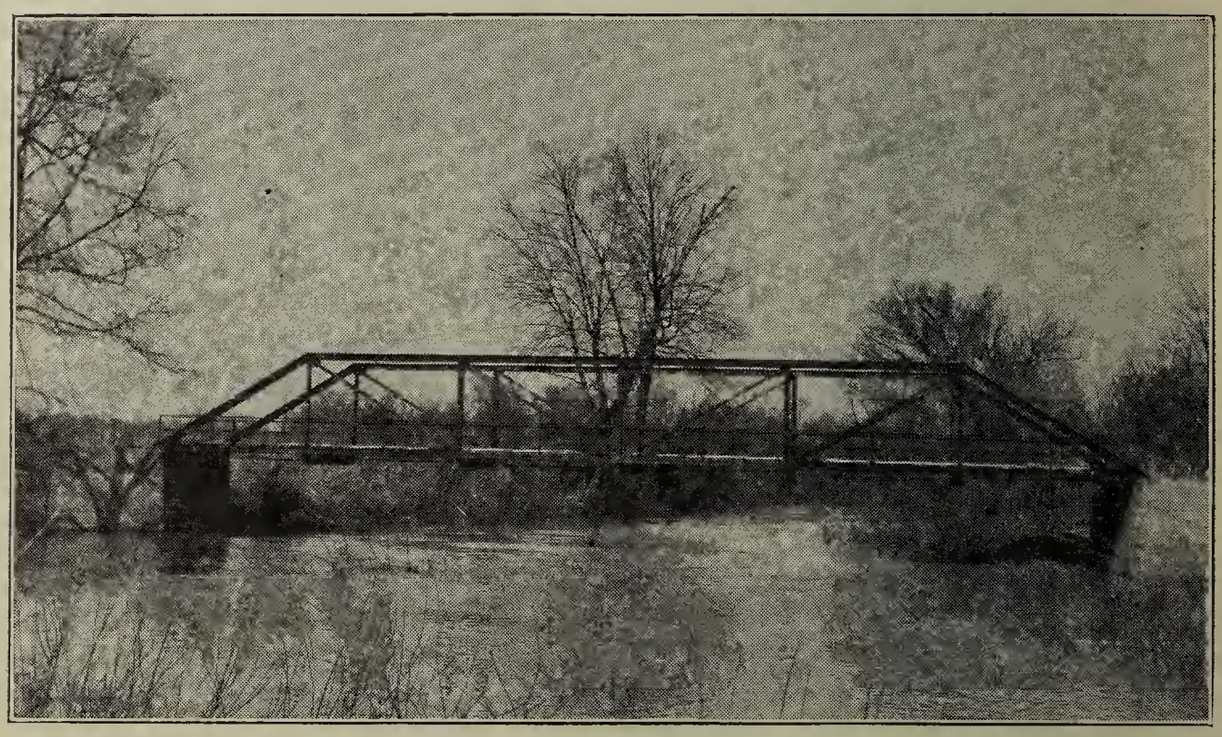
6.2 inches in 1 day.
7.8 inches in 2 days.
8.9 inches in 3 days.
9.2 inches in 4 days.

Once in 100 years

6.3 inches in 1 day.
9.8 inches in 2 days.
10.4 inches in 3 days.
10.4 inches in 4 days.

Having no rating curve, flow measurements, or gaugings to guide us, it is a very difficult matter to estimate closely the flow or discharge of Bay Creek. Run-off is that part of the rainfall that finally reaches the streams. Its amount depends upon many things such as the rate and duration of the storm, size of watershed, number of tributary streams or branches, amount of evaporation, slope of the ground, character of the

soil, vegetation, timber, amount of ploughed or cultivated ground, etc. In an area of the size of the Bay watershed, it is unusual that a very excessive rain would fall at one time over the entire area and even so the run-off would not all reach the main stream at one time. It is very



Highway Bridge over Bay Creek east of Reevesville. Note right angle bend shown by bushes in foreground.

Upstream from Highway Bridge east of Reevesville.

unlikely that a region like the Bay watershed would have a run-off of over 50 per cent, and that amount is the one assumed herein on a rainfall of 4 inches per day. This equals a run-off of 2 inches on a 100 square

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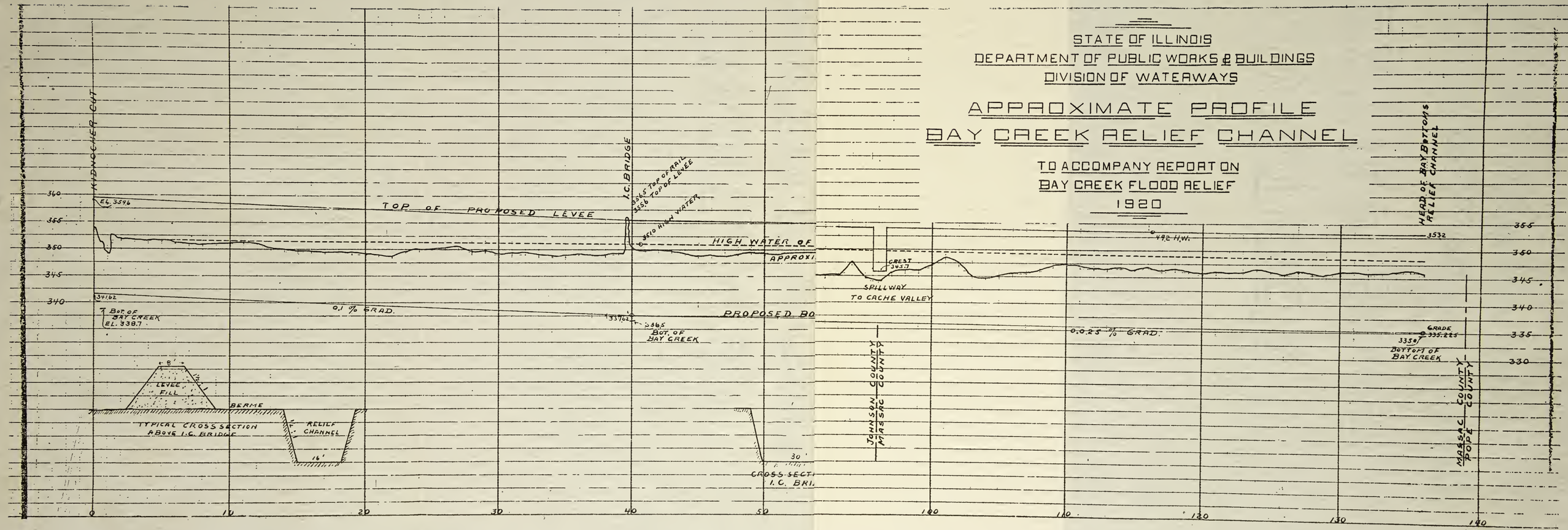
STATE OF ILLINOIS
DEPARTMENT OF PUBLIC WORKS & BUILDINGS
DIVISION OF WATERWAYS

APPROXIMATE PROFILE
BAY CREEK RELIEF CHANNEL

TO ACCOMPANY REPORT ON
BAY CREEK FLOOD RELIEF
1920



mile area, which amounts to 464,640,000 cubic feet per day, or 5,377 cubic feet per second.

Capacity of Bay Creek.

At Kidnocher Cut the bankful area of the Bay is 857 square feet. The fall of the bank level from there to the I. C. bridge (6,000 feet) is about 4 feet. Using .03 as the value of "n" in Kutter's formula, this gives a velocity of 5.45 feet per second, and a discharge of 4,671 c. f. s.

From the I. C. bridge to the head of the present bay bottoms relief channel the slope is considerably less and the discharge figures out to be about 3,634 c. f. s., bank full.

Below the head of the bay bottoms relief the main stream has about the same discharge as the last, and to it should be added the discharge of the relief channel, amounting to about 2,415 c. f. s., so that the combined flow here is about 6,049 c. f. s.

These quantities show that the point of least flow in the Bay is between the I. C. bridge and the bay bottoms relief, and that for that section the discharge is about equal to a run-off of 1.36″ for the area of 10[illegible] square miles above that point. Above the I. C. bridge the run-off equals 1.74″ on a 100 mile area, and on the lower section the combined discharge of 6,049 c. f. s., equals a run-off of 2.25″ on the same area.

Methods of Flood Control.

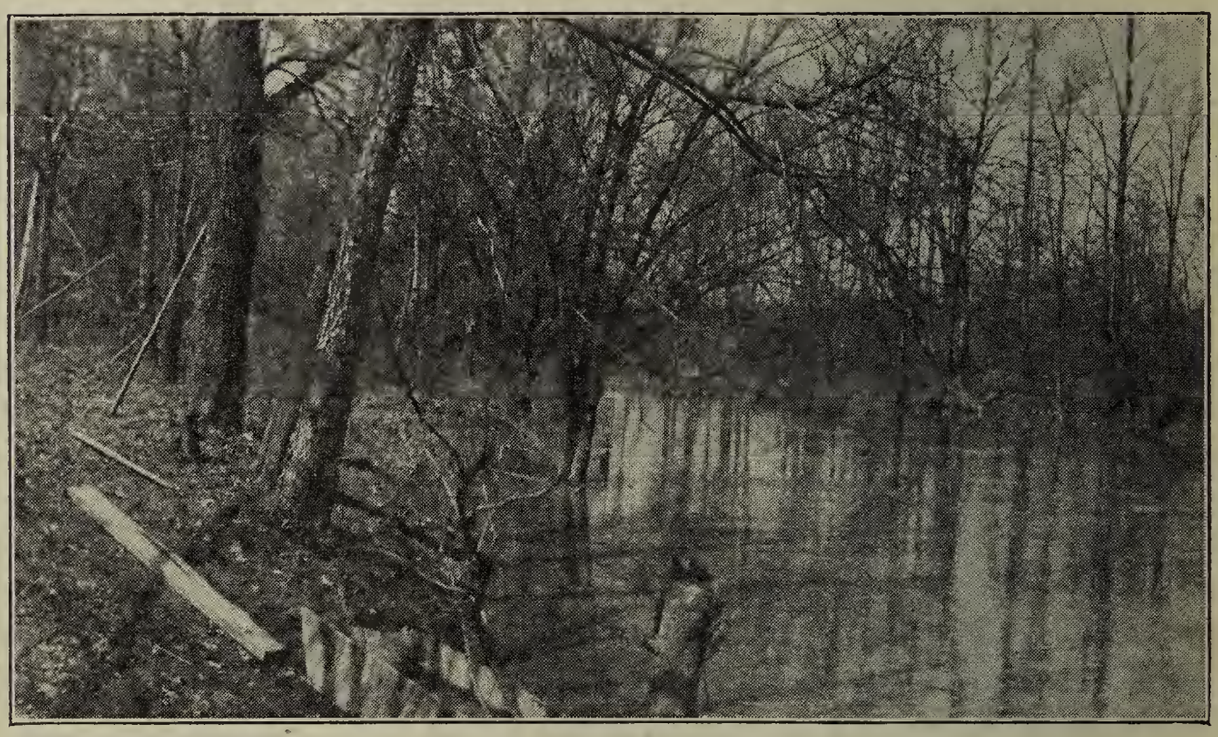
Flood waters may be cared for or controlled in three ways; first, by protection levees. These, while affording temporary protection, are always a source of danger in time of floods, needing constant care and maintenance in addition to their first cost.

Second, channel enlargement. These with or without the construction of levees have been the ordinary method of flood protection until the last few years. Both of these methods are for protection only at the actual time of flood, and do nothing to reduce the quantity of water passing.

Third, storage reservoirs. The third method of control, which has been rapidly coming to the front in recent years, is that of storing the excess waters in the upper reaches of the streams and allowing only such a discharge as will be cared for within the stream banks, thus removing the flood danger by extending the time of the excess flow. This is the ideal method of flood control. It is being used largely at the present time both in the upper waters of the Ohio above Pittsburgh, and in the Miami Conservancy District near Dayton, Ohio.

Bay Creek is well adapted to storage reservoir. By building one reservoir on Bay Creek itself and possibly a smaller one on its tributary, Sugar Creek, all danger from flood waters would be immediately removed. There would be no excess waters beyond the carrying capacity of the stream; no water passing over the banks and into the Cache valley; the bottom lands could be safely cultivated without fear of loss

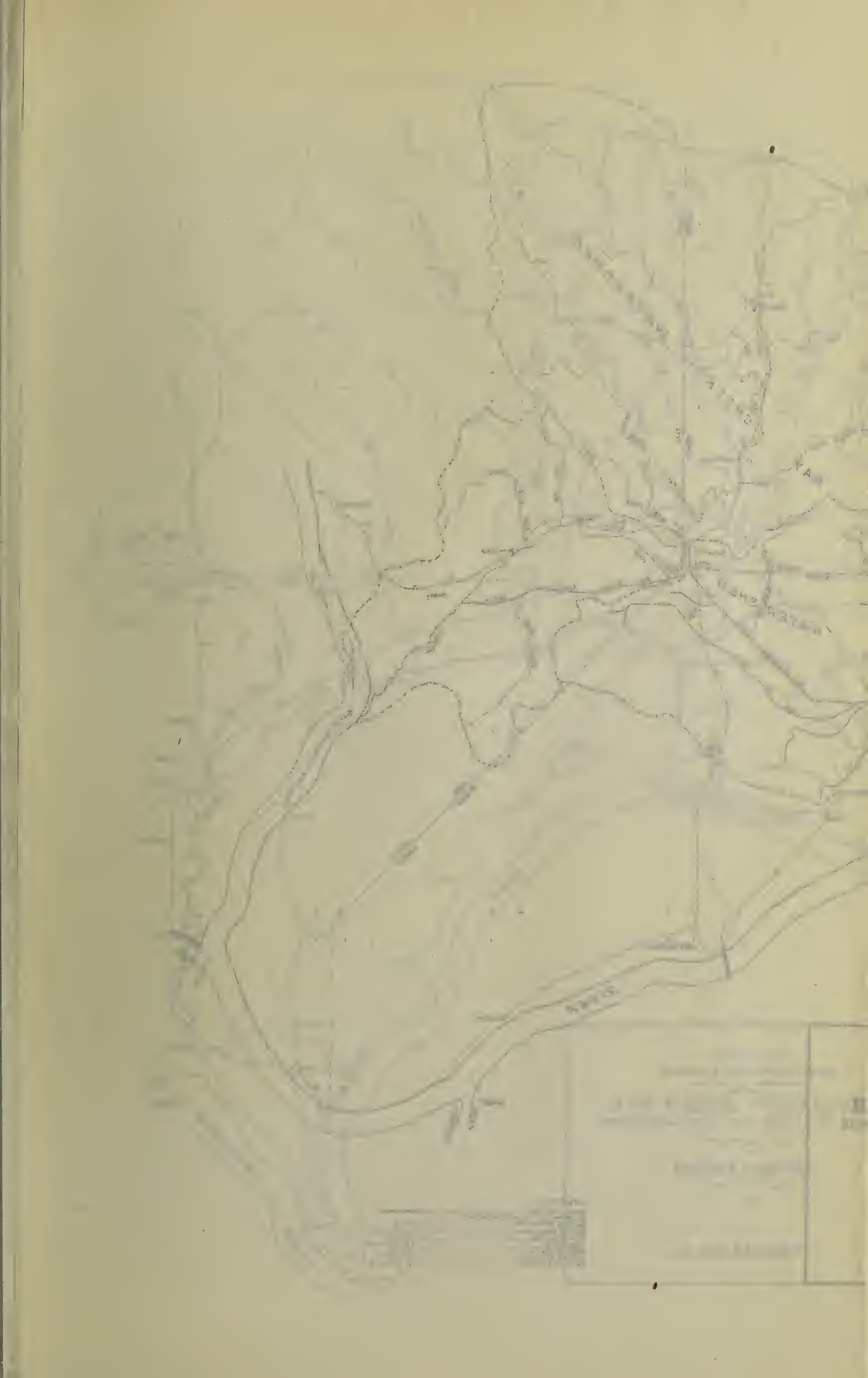
of crops or time; and there would be no question between residents of the Bay and Cache districts as to the proper amount of water each district should receive.



Bay Creek at Kidnocher Cut.

Condition of Reevesville Ditch of Cache River District looking east from I. C. Bridge between Reevesville and Big Bay stations.

To construct these storage basins, natural reservoirs should be selected where a short low dam across the valley would impound a large volume of water with the least possible damage to land, railroads, highways or improvements of any kind. An open concrete or masonry



STATE OF ILLINOIS
DEPARTMENT OF PUBLIC WORKS AND BUILDINGS
DIVISION OF WATERWAYS
BAY CREEK WATERSHED
JOHNSON, MASSAC AND POPE CO'S., ILLINOIS
To Accompany Report
on
BAY CREEK FLOOD RELIEF
By W.G. Porter, Drainage Engr.
1920
Adapted from Map of D.L. Yarnell, U.S. Department of Agriculture.
LEGEND:-
Dredged Ditches
Established Ditches (not constructed)
Surface Elevations 343.8
Bottom Elevations (337.4)
Elev. Top of Rail T.R. 356.
High Water H.W. 1910 - 352.4
Width of Channel 12/4
District Boundary
Watershed Lines
BAY CREEK WATERSHED
CACHE RIVER WATERSHED
OHIO RIVER
MISSISSIPPI RIVER
CACHE RIVER
CACHE RIVER
BAY CREEK
Approx. High Water Apr. 7, 1913 - 348.9
Approx. High Water Apr. 7, 1913 - 332.7
Approx. Average High Water - 322.8
Average Low Water - 283.0
Hitterman Landing
Joppa
Cairo
Mound City
Metropolis
Brookport
Golconda
Tennessee River
Cumberland River
Pulaski
Ullin
Rago
Karnak
Vienna
Simpson
Grantsburg
Cypress
Dongola
Elco
Wayne
Warner
Tamms
Sandusky
Unity
Beech Ridge
Mounds
Villa Ridge
America
Olmstead
Grand Chain
Belknap
Mermet
Cheat
Round Knob
Brownfield
Parkins
Bay Creek Relief Ditch
New Columbia Ditch
Bear Cr. Ditch
Post Cr. Cut-off
Mill Creek
Cooper Creek
Big Creek
Lick Creek
Cache Creek
Little Cache Creek
Dutchman Creek
Cave Creek
Johnson Creek
Mill Creek
Tunnel Hill
Hayes Creek
Sugar Hills Branch
Flat Lick Branch
Root Lick Branch
Bolnett Creek
Broadshaw Creek
Lick Creek
Lingle Creek
Kill Creek
Sucker Ditch
Island
Island
Pulaski County
Johnson County
Massac County
Pope County
Union County
Alexander County
Pulaski County
Massac County
Pope County
Cumberland River
Tennessee River
Mississippi River
Ohio River
Cache River
Bay Creek
Bay Creek Relief Ditch
Bear Cr. Ditch
New Columbia Ditch
Post Cr. Cut-off
Mill Creek
Cooper Creek
Big Creek
Lick Creek
Cache Creek
Little Cache Creek
Dutchman Creek
Cave Creek
Johnson Creek
Mill Creek
Tunnel Hill
Hayes Creek
Sugar Hills Branch
Flat Lick Branch
Root Lick Branch
Bolnett Creek
Broadshaw Creek
Lick Creek
Lingle Creek
Kill Creek
Sucker Ditch
Island
Island

culvert should be built through the dam in the bed of the channel large enough only to carry a flow which, with the tributary waters coming in below, would form a total within the bank limits of the stream in the danger zone. With this stream running through the dam at all times only excess water would be held back or stored, and only in extremely heavy storms would the reservoir be fully used.

Land would have to be purchased outright for the area covered by the water stored in the ordinary heavy storms coming possibly two or three times a year, but for land covered only at long intervals arrangement might be made with the owner to pay only for actual damage to crops. The reservoirs should and could be located so that no railroads would be affected although possibly a few highway bridges might have to be raised.

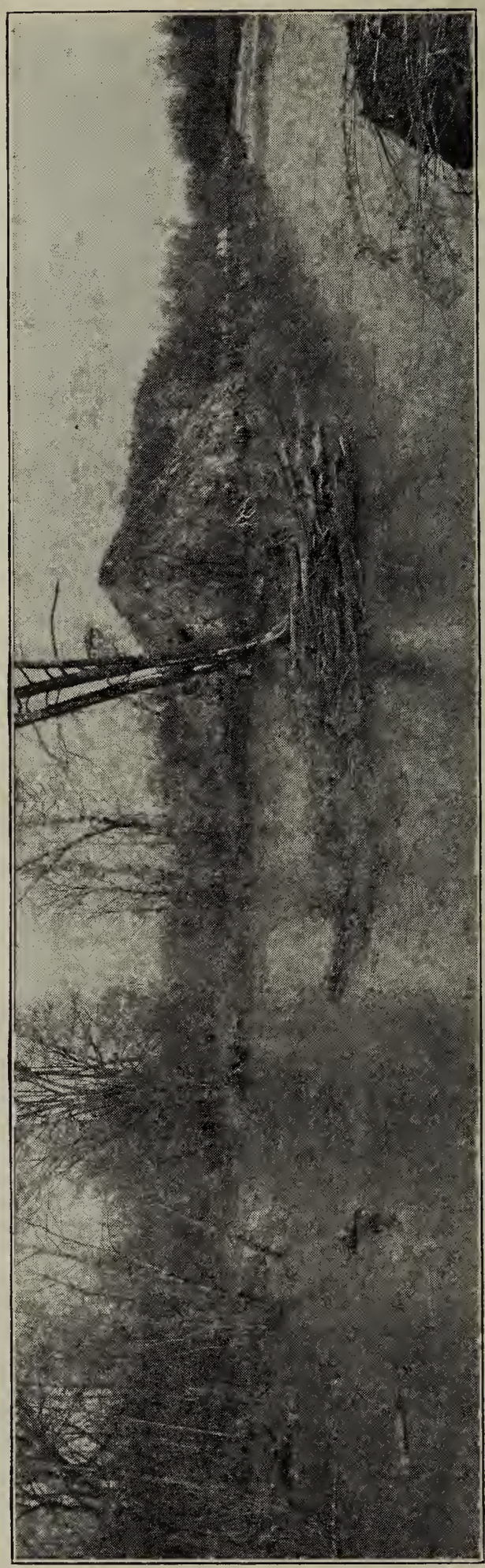
While we have no data from which we could determine the exact area of any one storage basin, the United States geological maps show us that there are numerous places where they could be easily and economically established. For example, on Bay Creek a dam could be located in the northern part of Sec. 36, T. 12, R. 4 E., and just east of the north and south highway bridge. With a length of perhaps 1,000 feet and a height of 20 feet this dam would give a basin of approximately 2 square miles area and a capacity of some 550,000,000 cu. ft., which is a run-off of over 3 inches on a 75 mile area.

Also, on Sugar Creek a very suitable place for a storage basin could be found by locating a low dam in the SW. quarter of Sec. 20, T. 13, R. 5 E. With a depth of 20 feet at the dam an area of 0.9 square miles would be covered with a capacity of about 227,000,000 cu. ft. This equals a run-off of 2″ on an area of 50 square miles. In both cases this is in addition to the flow passing through the open culvert. No railroads would be interfered with on either of these sites, and but few wagon roads or bridges would have to be raised or altered.

Relief Channel Plan.

As an alternative to the storage relief plan is the plan of relief channel along the west bank of Bay Creek, with its accompanying levee, entirely keeping the flood waters in the Bay valley. This plan ignores the fact that excess flood waters for all time past have gone from the Bay to the Cache valley. In detail this plan would in most respects agree with the plans already reported favorably upon by others.

The accompanying profile will show the plan favored by the writer. It includes a relief channel starting at Kidnocher Cut with 16 foot bottom and slopes of ½ to 1 and a grade of 0.1 per cent. It should not connect with the Bay at its upper end, but should merely take the overflow from it. At the I. C. R. R. and at the highway east of Reevesville, the new ditch should pass under new trestles at the west end of the present bridge.



Head of Bay Bottoms relief channel at right. Original channel Bay Creek at left. Looking down stream.

From the I. C. bridge to the connection with the Bay Bottoms Relief Channel, because of the flatter ground slope, the bottom width should increase to 30 feet. This, with a 12 foot average depth will give a capacity above the I. C. R. R. of 1,420 c. f. s., which, added to that of the Bay itself bank full, would give a total capacity of about 6,091 c. f. s.

Below the I. C., the capacity of the relief channel would be about 1,450 c. f. s. and with the Bay, a total of 5,079 c. f. s., equal to a run-off of about 1.9 inches per day on an area of 100 square miles.

The previous plans call for the relief being obtained over part of the distance by widening the Bay itself. In order to keep the relief ditch on a uniform grade and give it its fullest capacity, the writer would advise a separate channel all the way. Otherwise, the bottom of the relief would have to coincide with the main stream, which is practically level towards the lower end of the section in question.

The material excavated from this relief channel should be thrown up as a levee on the west side of the ditch with uniform top grade at least 18 feet above the bottom of ditch. Thus a continuous levee would be formed which would keep all Bay Creek water in its own channel and relieve the Cache valley from any overflow.

This plan is entirely based on the engineering point of view "regardless of court questions." Should the courts decide that some of the flood waters must go to the Cache district, the same plan would be applicable as far as the ditch and levee are concerned, except that at some point, preferably one near the Johnson-Massac County line, a spillway be built which would allow part of the flood waters to go from the Bay to the Cache valley. This spillway, if built, should be placed about at station 95 on the profile. It should be at least 100 feet long, of concrete, with its crest about 4 feet below the high water line of 1910, the highest on record. In order to get some idea of this high water line, elevations were obtained on several points given by residents as the height of the 1910 flood as follows:

I. C. Bridge (station, 40 on profile)	351.0
Reevesville station	350.72
Reevesville store step	351.17
House near station, 115 on profile	349.2

A line drawn on the profile from the first elevation above to the last will give a close approximation to the high water gradient. This shows at the spillway location an elevation of 349.7. From this we obtain a spillway crest of 345.7, which will yield a capacity of about 2,600 c. f. s. over the weir with flood at highest water known.

The main benefit of this plan would be the concentration of the excess waters flowing to the Cache. They would be confined to a certain channel instead of extending over the whole area of bottoms around Reevesville.

The objections to it are numerous. It would mean a new channel from the spillway to the Reevesville ditch of the Cache district, a heavy

widening and deepening of the Reevesville, New Columbian and main ditches through the miles of their length, to avoid flooding the cultivated bottoms, new or extended bridges over railroads and highways. It would furthermore always be a likely source of contention between the Cache and the Bay Creek districts as to the proper amount of water going over the spillway. It would also mean a heavy maintenance charge and a first cost probably equalling, if not exceeding, the storage plan.

Maintenance.

Before closing this report the writer wishes to emphasize the necessity for maintenance work on any stream of the character of Bay Creek. Any stream flowing through a tortuous channel through timber and underbrush, as does the Bay, is bound to clog up with drift and debris. Also, the sloughing of banks causes much stoppage of flow and a corresponding diminution of discharge capacity. For example, at the head of the bay bottoms relief channel, at the time of the writer's visit, a large island of debris was just above the opening to the relief and a long point of land between the relief channel and the Bay further stopped the flow. At another point on the bay bottom relief a bridge abutment had been undermined and fallen into the channel. It is strongly recommended that the stream throughout the danger zone be maintained free from obstructions of any kind.

Further Study.

Recognizing the fact that the State is unable to make further or detailed study of the situation, it is strongly recommended that the Cache and Bay Creek districts combine and establish stream gauges at the following points:

On I. C. bridge over the Bay.
On I. C. bridge over Sugar Creek.
On Bay Creek bridge near Dixon Springs station.
On bay bottoms relief channel at first bridge east of its head.

These, if read every day, or even if read during high water periods only, in conjunction with cross sections of the streams at those points, would give an excellent index to the flow. With the aid of the engineer of the Cache River district these gauges could easily be established. Arrangements should then be made with nearby residents for reading and recording the results.

Recommendations.

First and foremost in the line of recommendations the writer would advise, as mentioned in the last paragraph, the employment of a competent engineer by the two districts combined to make a detailed and complete study of the question of relief by storage reservoirs. It is our belief that the permanent and final solution of the entire question can be found right here at an expense not beyond the reach of the districts.

The recommendation of the writer is that beyond all question the best remedy for the flooding waters is by means of storage basins in the Upper Bay Creek and possibly one in Sugar Creek for the following reasons:

1. It subjects less land to overflow and gives more to cultivation.
2. The land subjected to overflow for storage purposes is less valuable than the land now subject to overflow.
3. Its final cost and possibly its first cost would be no greater than for the other method.
4. It would allow farmers in the bottoms now subject to overflow to feel secure from such floods in the future.
5. It would be a final solution for all time, and would give a feeling of unanimity between the residents of both districts.

As the alternative the writer would recommend that the relief ditch and continuous levee be built as above outlined, keeping all Bay Creek waters in the Bay district.

As shown in the report of D. L. Yarnell of the Bureau of Public Roads, U. S. Department of Agriculture, made this year, the Cache district will be under heavy expense to care properly for the waters of the Cache district alone, and the addition of a large amount of water from the Bay valley would necessitate much greater expense than to care for it in the Bay watershed itself.

W. G. Potter,
Drainage Engineer, Division of Waterways.

SALINE RIVER INVESTIGATION

At the request of Representative K. C. Ronalds of Eldorado, and citizens of Harrisburg in September, 1919, this division made an investigation of the best method of disposal of flood waters of the Saline River.

For several years the water supply of Harrisburg has been periodically contaminated because of flood waters backing up and covering sewer outlets. The situation was growing yearly more serious. Not only was there a question of health involved for Harrisburg, but losses resulting from unnecessary flooding of thousands of acres of productive agricultural lands had reached a large sum annually.

After a preliminary trip in January, 1920, to see the extent of survey necessary, a field party was organized in charge of W. G. Potter, drainage and sanitary engineer of this division, and field work started in March, 1920.

The investigation indicates permanent relief may be obtained by deepening the channel and removing the shoals at what is known as the "gorge" and a widening and deepening of the channel between Harrisburg and the so-called "gorge." Provision of storage basins to retain part of the flood flow is also suggested.

The report follows:

REPORT ON FLOOD RELIEF FOR THE SALINE RIVER

General Description of Saline River.

The Saline River is a stream in the southern part of Illinois flowing in general towards the southeast and emptying into the Ohio about ten miles below Shawneetown. It is formed by the union of three principal tributaries, the North Fork, Middle Fork, and South Fork, or Saline Creek.

Saline Creek has its head waters on the northern slopes of the Ozark uplift in Williamson, Johnson, and Pope Counties, and runs easterly to a junction with the Middle Fork at a point southeast of Harrisburg in Saline County. Its general characteristic is the sharp slope of the watershed on the south side of the stream and the flat slope on the north side. After reaching Saline County it is flat and very tortuous. The area of the watershed of this fork is approximately 240 square miles, of which about 25 square miles is in organized drainage districts.

Middle Fork rises in Franklin, Williamson, and Hamilton Counties and flows southeasterly through Saline County to its junction with Saline Creek, and then eastwardly to a point about a mile east of Equality where it unites with North Fork. In general, the slope of this stream is rather flat and its course is very winding and tortuous. Of its total area of 225 square miles, some 56 miles is organized in districts.

North Fork is the largest tributary of the Saline. It drains the southern parts of Hamilton and White and the northern part of Saline Counties, and flows south through Gallatin County to its junction with Middle Fork and thence east and south till it joins the Ohio. Its area is about 385 square miles of which 66 is included in drainage districts. North Fork is very winding in its course, and is entirely unimproved in practically all of that part lying in Gallatin County.

Below the union of these tributaries the area drained by the Saline is some 88 square miles, thus giving a total area for the Saline watershed of 940 square miles, of which 150 is in drainage districts.

The general character of the territory drained by the Saline is flat excepting along the southern border where the Ozark uplift rises abruptly from 300 to 500 feet above the level of the plain. The river is usually bordered by heavy timber and much underbrush, but away from the stream the land is fertile and mostly cultivated. Where drainage districts have been organized, tributary ditches have been dug and trees and drifts removed from the main stream; therefore, the water gets to the river much quicker than before the improvement. These districts however, include only the best agricultural lands, and while each district tries to drain its own land effectively and quickly, no attention is paid to the stream below the confines of its own territory. The unimproved portions of the stream are usually full of bends and crooks with beds full of sunken logs and drift, with banks lined with fallen trees, and

grown up with weeds and underbrush, and in many places the stream itself is narrow. Therefore, although the discharge of the stream is greatly increased and accelerated by the drainage ditches, the conditions below invariably greatly retard both the velocity and discharge, conse-

Highway bridge over Saline River at Equality during high water.

Highway bridge over Saline River at Equality during low water.

quently the waters pile up until they overflow the banks and flood the adjacent property.

A good example of this is found on North Fork near Texas City, where a very good drainage ditch, with clean bottom and smooth slopes, discharges a large amount of water into the unimproved stream just west

of the Gallatin County line. Flowing into North Fork, possibly half a mile below this ditch, is Brush Creek. In times of high water a very heavy stream flows out of this drainage ditch, forcing its way through the unimproved North Fork and backing up into Brush Creek. The banks of this creek are low and consequently hundreds of acres of good tillable land are overflowed several feet deep. Similar results are seen on each of the tributary streams.

Saline River High Waters.

High waters on the Saline are of two kinds. One, called the backwater flood, is caused by the rising of the Ohio River to or beyond flood stage. This comes once or twice a year, but does not usually reach a stage to seriously affect much land above Equality. Occasionally, however, back waters are much more disastrous. In the 1913 flood, lands were covered on the South and Middle Forks to points considerably west of Harrisburg and on North Fork beyond Texas City. These backwater floods are unavoidable except by building levees on both sides of the river and all of its branches, and using pumps at high water times for the water accumulating outside of the levees. This would be beyond any reasonable cost, and consequently backwater floods are not considered in this report.

The other type of high water, called the headwater flood, is caused by excessive rains falling on this watershed. These floods come with every excessive storm and on each fork, but are especially damaging near the city of Harrisburg. A few miles southeast of here is the junction of Saline Creek with Middle Fork, and the crest of the flood from each one reaches the junction at about the same time. In consequence, the water backs up over the land all around Harrisburg, preventing planting or destroying crops after they are planted. In addition to this, the sewer system of Harrisburg is flooded at each overflow, causing a backing up of the sewage into the mains of the city with its accompanying danger to the health of the city. To prevent these headwater floods, or to alleviate them as much as possible, is the aim of this investigation.

Rainfall.

Before taking up the methods of flood protection it will be necessary to obtain a knowledge of the amount of rainfall and its run-off. There are no available records of stream measurement on this river; therefore, the run-off, or discharge, will have to be estimated from the rainfall records. For this purpose the rainfall statistics from four U. S. Weather Stations have been tabulated and studied. The stations used are as follows:

Equality, located on the Saline near the mouth of North Fork, with record from 1898 to 1920.

Shawneetown, located on the Ohio near the mouth of the Saline, with record from 1912 to 1920.

McLeansboro, near the headwaters of North Fork, with record from 1896 to 1920.

New Burnside, in the Ozark Hills, near the headwaters of South Fork, with record from 1896 to 1920.

TABULATION A—EXCESSIVE STORM DATA

Duration.	Depth.	Equality 1898 to 1920.		Shawneetown 1912 to 1920.		McLeansboro 1896 to 1920.		New Burnside 1896 to 1920.	
		Number of storms.	Average Depth.	Number of storms.	Average depth.	Number of storms.	Average depth.	Number of storms.	Average depth.
1 day	2 inches or over	49	2.76	16	2.72	34	2.77	50	2.73
	3 " " "	13	3.65	5	3.46	8	4.24	12	3.80
	4 " " "	4	4.51	1	4.00	4	5.14	3	5.37
	5 " " "	1	5.47	0	--------	2	5.86	2	6.03
	6 " " "	0	--------	0	--------	1	6.40	1	6.23
2 days	3 inches or over	32	3.99	9	4.18	16	4.08	27	4.06
	4 " " "	9	5.37	3	4.39 (Max. 4.80)	5	5.69	5	6.74
	5 " " "	3	7.60	--------	--------	4	6.02	4	7.23
	6 " " "	2	8.90	--------	--------	2	6.26 (Max. 6.40)	2	8.97
	7 " " "	2	8.90	--------	--------	--------	--------	2	8.97
	8 " " "	1	10.71	--------	--------	--------	--------	1	10.72
3 days	3 inches or over	43	4.10	14	3.88	24	4.10	37	4.05
	4 " " "	19	5.00	5	4.74	8	5.42	12	5.55
	5 " " "	3	8.32	1	6.75	5	6.02	4	8.00
	6 " " "	2	9.92	1	6.75	3	6.44	4	8.00
	7 " " "	2	9.92	--------	--------	0	--------	3	8.94
	8 " " "	1	12.75	--------	--------	--------	(Max. 6.80)	1	12.09
4 days	4 inches or over	23	5.08	5	4.99	13	5.01	12	5.96
	5 " " "	6	7.04	1	7.08	5	6.25	6	7.60
	6 " " "	3	8.64	1	7.08	4	6.41 (Max. 6.96)	5	8.09
	7 " " "	2	9.92	--------	--------	--------	--------	4	8.53
	8 " " "	1	12.75	--------	--------	--------	--------	1	12.20
5 days	4 inches or over	27	5.14	10	4.71	16	4.97	13	6.01
	5 " " "	7	7.23	2	6.20	6	6.10	7	7.46
	6 " " "	5	7.95	1	7.09	4	6.46 (Max. 6.96)	5	8.37
	7 " " "	3	8.97	1	7.09	--------	--------	4	8.75
	8 " " "	1	12.75	--------	--------	--------	--------	2	10.12
	9 " " "	1	12.75	--------	--------	--------	--------	1	12.20
6 days	4 inches or over	31	5.25	12	4.80	19	5.05	23	5.27
	5 " " "	11	6.83	4	5.84	8	6.08	7	7.56
	6 " " "	7	7.48	1	7.09	4	6.78	5	8.51
	7 " " "	3	8.97	1	7.09	1	8.22	4	8.91
	8 " " "	1	12.75	--------	--------	1	8.22	3	9.45
	9 " " "	1	12.75	--------	--------	--------	--------	1	12.20

TABULATION B—MAXIMUM RAINS

Period.	Equality.	Shawneetown.	McLeansboro.	New Burnside.	Average.
1 day	5.47	4.00	6.40	6.21	5.52
2 days	10.71	4.80	6.40	10.72	8.16
3 days	12.75	6.75	6.80	12.09	9.60
4 days	12.75	7.08	6.96	12.20	9.75
5 days	12.75	7.09	6.96	12.20	9.75
6 days	12.75	7.09	8.22	12.70	10.19

TABULATION C—AVERAGE OF EXCESSIVE RAINS IN FOUR TOWNS

DEPTH	1 DAY	2 DAYS	3 DAYS	4 DAYS	5 DAYS	6 DAYS
2" OR OVER	2.72					
3" " "	3.80	4.05	4.06			
4" " "	4.89 4 TOWNS	5.62	5.20	5.26	5.36	5.15
5" " "	5.85 3 TOWNS	6.89	7.21	7.01	6.90	6.67
6" " "	2 TOWNS 6.30	8.04	8.08	7.62	7.64 4 TOWNS	7.60
7" " "		8.94 2 TOWNS	9.33	8.73 3 TOWNS	8.62	8.65
8" " "		10.72	12.42	12.47 2 TOWNS	11.03	3 TOWNS 9.86
9" " "		10.72	12.42	12.47	12.47	12.47
10" " "		10.72	12.42	12.47	12.47	12.47
11" " "			12.42	12.47	12.47	12.47
12" " "			12.42	12.47	12.47	12.47

From the records of these four stations all excessive storms have been tabulated with their intensity for periods of one, two, three, four, five and six days.

Tabulation "A" shows the number of storms at each of the above stations exceeding two inches in depth with their average depth, and the number of storms at each additional inch of depth until the maximum storm is reached. This is shown also for periods of from one to six days.

Tabulation "B," for easier inspection, shows the maximum rainfall for each period.

Tabulation "C" shows the average intensity of storms of from one to six days' duration, and from two inches in depth to the maximum. It is obtained by averaging the storms at the four stations, and is assumed as the average of intensity and duration for the entire watershed.

Quoting from these tabulations, we find that we have had the following storms of excessive rainfall:

"At Equality in a 22 year record:

4 storms of over 4 inches in a 1 day period.
3 storms of over 5 inches in a 2 day period.
2 storms of over 6 inches in a 3 day period.
2 storms of over 7 inches in a 4 day period.
1 storm of over 8 inches in a 5 day period.
1 storm of over 8 inches in a 6 day period. (12.75 inches).

"At Shawneetown in an 8 year record:

1 storm over 4 inches in 1 day period.
0 storm over 5 inches in 2 day period.
1 storm over 6 inches in 3 day period.
1 storm over 7 inches in 4 day period.
1 storm over 7 inches in 5 day period.
1 storm over 7 inches in 6 day period. (7.09 inches).

"At McLeansboro in a 24 year record:

4 storms over 4 inches in 1 day period.
4 storms over 5 inches in 2 day period.
3 storms over 6 inches in 3 day period.
4 storms over 6 inches in 4 day period.
4 storms over 6 inches in 5 day period.
1 storm over 8 inches in 6 day period. (8.22 inches).

"At New Burnside in a 24 year record:

3 storms over 4 inches in 1 day period.
4 storms over 5 inches in 2 day period.
3 storms over 6 inches in 3 day period.
4 storms over 7 inches in 4 day period.
2 storms over 8 inches in 5 day period.
3 storms over 8 inches in 6 day period. (Maximum 12.20 inches).

MONTHLY RAINFALL AT EQUALITY, ILLINOIS

FROM THE U. S. WEATHER REPORTS

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
1899	5.79	3.12	5.35	3.09	3.86	3.53	10.04	1.80	3.14	4.25	2.32	2.83	49.12
1900	2.41	4.22	2.43	1.87	3.89	9.93	2.07	1.15	2.81	1.50	4.07	2.12	38.47
1901	0.65	1.76	3.26	3.06	1.65	3.02	2.11	3.39	0.85	4.74	1.54	3.53	29.56
1902	2.55	1.03	3.09	3.09	2.71	1.84	1.69	3.39	3.74	1.06	4.91	5.17	34.27
1903	2.67	4.44	7.27	3.53	2.60	2.40	1.83	1.62	0.60	2.17	1.29	2.74	33.16
1904	4.39	3.49	7.80	4.09	3.33	3.95	3.69	2.70	8.85	2.05	0.39	2.66	47.39
1905	2.77	1.70	3.05	3.38	4.91	2.21	9.40	3.78	1.88	7.72	2.82	3.30	46.92
1906	7.60	1.99	6.88	2.16	1.48	2.88	3.93	6.33	5.06	1.56	7.75	7.52	55.14
1907	10.90	1.35	4.13	3.25	6.47	5.53	1.96	8.07	1.67	3.88	4.96	3.73	55.90
1908	2.85	6.58	5.21	5.85	6.20	2.45	4.34	3.81	0.44	0.05	2.69	1.30	41.70
1909	3.48	6.14	3.98	6.29	3.08	2.56	8.19	0.46	2.55	1.98	3.83	3.86	46.40
1910	2.37	3.80	T.	5.30	2.70	2.84	9.26	3.94	3.51	13.17	0.24	3.05	50.18
1911	1.53	2.23	2.03	10.30	1.19	1.51	2.43	6.97	5.07	2.58	3.06	3.61	42.51
1912	4.50	3.73	6.12	7.06	4.15	4.26	5.93	8.00	5.42	1.65	1.57	0.93	53.32
1913	9.89	1.34	7.77	3.07	1.22	0.62	2.35	1.61	3.68	3.98	3.93	1.54	41.00
1914	2.38	6.26	3.98	3.14	1.38	2.00	1.34	8.28	5.83	4.97	1.05	4.24	44.85
1915	5.19	1.94	1.22	1.20	7.87	6.85	4.66	6.26	5.14	0.69	4.49	9.08	54.59
1916	8.61	1.64	------	2.85	2.45	6.75	3.18	10.93	1.67	2.22	1.46	4.40	------
1917	4.62	1.42	3.63	7.16	5.05	3.33	3.29	4.03	1.73	2.32	1.80	1.34	39.72
1918	4.66	0.36	1.14	6.85	7.53	3.86	0.15	3.57	4.96	3.39	2.08	5.79	44.34
1919	1.07	1.67	6.09	3.20	7.48	4.83	1.60	3.65	2.39	Di	sconti	nued	

MONTHLY RAINFALL AT McLEANSBORO, ILLINOIS

1896	------	------	------	------	------	4.55	4.38	1.29	3.91	1.73	2.39	0.70	------
1897	4.23	------	11.29	7.27	2.53	5.52	3.43	1.70	0.63	0.45	5.85	5.12	------
1898	4.98	1.29	11.11	5.38	6.05	4.99	3.57	5.15	2.75	3.77	1.26	1.69	51.99
1899	4.96	2.61	4.33	1.95	3.82	4.91	5.16	3.14	2.02	4.03	2.46	2.36	41.75
1900	1.24	3.52	------	2.08	5.34	6.13	4.45	0.63	3.07	1.53	3.97	1.25	------
1901	1.41	2.10	3.79	2.73	1.06	2.39	2.87	2.65	0.94	2.33	1.36	5.20	28.83
1902	1.93	0.96	3.83	2.18	------	2.68	2.21	2.71	2.49	0.85	3.65	5.27	------
1903	2.21	4.86	3.72	3.75	3.38	4.09	1.31	3.90	1.71	2.96	0.98	2.20	35.07
1904	3.78	3.49	8.89	3.93	3.32	4.67	5.48	2.12	10.11	0.40	0.94	3.17	50.30
1905	2.61	1.55	2.61	4.25	3.49	1.81	7.39	3.30	3.03	4.01	2.66	3.46	40.17
1906	6.20	2.74	5.38	1.46	0.50	2.89	1.92	4.35	5.43	1.76	5.32	6.01	43.96
1907	7.72	0.91	2.97	2.16	3.61	2.89	1.62	5.89	1.03	1.96	3.83	4.12	38.62
1908	2.35	7.55	4.45	7.10	6.60	0.65	2.83	2.17	0.41	T.	3.23	1.33	38.67
1909	3.08	6.63	4.13	6.55	3.66	3.13	6.34	0.31	3.72	1.52	3.44	3.58	46.09
1910	3.09	3.09	T.	2.45	2.96	3.13	3.57	2.57	5.03	7.84	0.56	2.06	36.35
1911	0.84	2.72	1.51	7.57	0.86	2.71	1.62	------	6.19	1.87	3.07	2.48	------
1912	2.92	2.75	5.40	6.45	3.10	4.68	6.76	4.48	4.88	1.49	2.65	0.93	46.49
1913	9.55	1.18	9.91	3.30	2.25	1.57	1.40	1.21	4.03	4.52	2.80	1.68	43.40
1914	------	------	------	3.77	0.34	1.91	0.68	2.70	2.94	3.06	0.28	3.80	------
1915	2.84	2.63	0.95	1.64	8.28	6.83	3.82	8.87	1.87	1.04	3.07	6.25	41.84
1916	9.29	1.90	1.73	1.77	3.11	5.06	2.71	6.19	2.15	2.31	1.82	3.88	41.92
1917	5.62	0.72	3.35	7.56	4.03	2.90	8.42	3.13	3.65	3.16	2.40	1.16	46.10
1918	5.03	0.80	1.04	7.11	7.33	4.40	0.32	7.89	3.81	2.64	2.36	7.53	50.26
1919	1.00	1.76	5.35	4.63	5.99	3.60	0.45	3.55	0.95	10.73	3.98	1.21	43.20
1920	2.99	0.51	6.43	1.97	7.55	------	------	------	------	------	------	------	------

MONTHLY RAINFALL AT NEW BURNSIDE, ILLINOIS

FROM U. S. WEATHER REPORTS

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
1896	1.33	1.20	2.86	3.36	9.44	5.90	4.90	2.54	2.54	1.74	3.14	0.68	39.63
1897	2.70	3.35	10.97	5.82	1.10	4.15	5.81	0.81	1.18	1.20	4.07	2.71	43.87
1898	4.67	1.07	8.51	3.76	7.28	2.77	5.82	3.28	4.33	4.35	0.99	2.24	49.07
1899	5.36	2.63	4.91	4.04	5.37	2.22	4.72	1.42	1.53	5.18	1.86	3.78	43.02
1900	1.84	3.36	1.89	2.08	3.90	9.08	3.43	0.77	2.36	2.74	3.99	1.61	37.05
1901	1.01	2.14	3.72	3.63	1.63	1.34	0.33	2.81	1.00	3.92	1.70	4.85	28.08
1902	2.89	0.77	3.08	3.49	3.20	3.40	2.04	4.33	5.07	0.78	5.71	6.03	40.79
1903	1.01	4.90	6.21	2.76	3.06	3.13	1.43	2.13	0.89	3.35	1.06	3.19	33.12
1904	4.49	2.92	7.48	5.06	3.11	3.83	5.24	2.33	5.31	1.74	0.51	3.20	45.22
1905	2.61	1.72	2.72	5.25	5.59	2.31	10.39	3.00	2.96	6.44	2.74	3.58	49.31
1906	6.65	2.54	6.68	1.32	1.66	3.11	4.76	4.88	5.43	0.86	8.33	8.31	54.53
1907	9.97	2.11	3.77	2.84	4.85	5.26	4.72	5.56	1.28	3.10	4.30	3.16	50.92
1908	2.84	7.67	3.18	6.52	5.31	1.94	3.74	3.13	1.31	T.	4.85	0.62	41.11
1909	2.60	5.35	3.02	5.45	4.01	4.67	3.28	0.15	5.47	0.83	4.09	3.06	41.98
1910	3.06	3.05	0.00	4.80	2.96	2.95	7.38	1.81	1.70	12.48	0.23	2.93	43.35
1911	T.	1.84	1.78	11.22	1.78	2.78	3.17	4.09	5.45	2.94	2.14	2.38	39.57
1912	3.16	1.92	4.66	5.84	3.65	4.70	3.14	4.04	3.50	1.77	1.58	1.39	39.35
1913	9.33	1.16	6.95	3.43	1.64	0.66	5.55	1.09	4.01	6.43	4.19	1.61	46.05
1914	2.06	5.75	3.18	2.49	1.50	1.53	1.97	1.82	3.83	4.20	0.80	3.46	32.59
1915	4.85	2.83	1.26	1.18	6.51	5.15	1.88	9.76	2.82	2.43	3.58	8.86	51.11
1916	10.38	1.69	2.17	3.87	2.12	5.90	1.69	6.22	2.11	2.16	2.02	4.97	45.30
1917	5.13	1.65	4.15	7.81	4.63	3.54	2.49	4.56	1.53	2.43	2.23	2.17	42.32
1918	5.53	0.63	1.46	7.14	9.20	1.24	0.71	5.38	5.09	2.32	2.96	7.22	48.88
1919	1.41	1.68	6.61	3.43	6.50	3.47	1.32	2.95	2.06	10.41	6.46	1.81	48.11
1920	4.46	1.25	7.88	3.06	9.25	------	------	------	------	------	------	------	------

MONTHLY RAINFALL AT SHAWNEETOWN, ILLINOIS.

1912	3.69	2.60	------	6.94	2.67	3.97	3.67	6.91	3.60	2.16	1.23	1.70	------
1913	11.35	1.80	------	3.90	1.02	1.28	1.96	0.45	3.07	2.87	4.42	1.85	------
1914	1.53	4.98	3.04	2.85	1.58	3.49	1.56	5.87	4.55	2.79	0.50	4.64	37.38
1915	4.95	2.00	1.40	0.53	8.69	6.34	3.88	7.39	4.11	2.14	3.38	8.99	53.80
1916	11.23	1.61	2.31	3.10	2.86	5.92	2.74	6.29	2.07	2.32	1.81	4.56	46.82
1917	5.52	2.18	4.33	6.55	5.17	3.94	2.73	2.54	1.03	2.67	2.48	1.84	40.98
1918	4.62	0.85	1.60	6.30	5.65	2.39	2.42	3.16	4.27	2.32	1.76	5.96	41.30
1919	1.57	1.68	7.01	2.47	7.09	3.17	1.00	2.48	1.16	7.27	7.70	2.54	45.14
1920	4.55	1.47	6.90	3.25	9.00	------	------	------	------	------	------	------	------

AVERAGE MONTHLY RAINFALL, EQUALITY, NEW BURNSIDE, McLEANSBORO AND SHAWNEETOWN, ILLINOIS.

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
1896	1.33	1.20	2.86	3.36	9.44	5.23	4.64	1.92	3.22	1.74	2.77	0.69	38.40
1897	3.47	3.35	11.13	6.55	1.81	4.84	4.62	1.25	0.91	0.82	4.96	3.91	47.62
1898	4.82	1.18	9.81	4.57	6.67	3.88	4.70	4.22	3.54	4.06	1.12	1.97	50.54
1899	5.37	2.79	4.86	3.03	4.35	3.55	6.64	2.12	2.23	4.49	2.21	2.99	44.63
1900	1.83	3.70	2.16	2.01	4.38	8.38	3.32	0.85	2.75	1.92	4.01	1.66	36.97
1901	1.02	2.03	3.59	3.14	1.45	2.25	1.77	2.95	0.93	3.66	1.53	4.53	28.85
1902	2.46	0.93	3.33	2.92	2.96	2.64	1.98	3.48	3.77	0.90	3.76	5.40	34.53
1903	1.96	4.73	5.73	3.35	3.01	3.21	1.52	2.55	1.07	2.83	1.11	2.71	33.78
1904	4.22	3.30	8.06	4.36	3.25	4.15	4.80	2.38	8.09	1.40	0.61	3.01	47.63
1905	2.67	1.66	2.79	4.29	4.66	2.11	9.06	3.36	2.62	6.06	2.74	3.45	46.47
1906	6.82	2.42	6.31	1.65	1.21	2.96	3.54	5.19	5.31	1.39	7.13	7.28	51.21
1907	9.53	1.46	3.62	2.75	4.98	4.56	2.77	6.48	1.33	2.98	4.36	4.30	49.12
1908	2.68	7.27	4.28	6.49	6.04	1.68	3.64	3.04	0.72	0.02	3.59	1.08	40.53
1909	3.05	6.04	3.71	6.10	3.58	3.45	5.94	0.31	3.91	1.44	3.79	3.50	44.82
1910	2.84	3.31	T.	4.18	2.87	2.97	6.74	2.77	3.41	10.19	0.34	2.68	42.30
1911	0.79	2.26	1.77	9.70	1.28	2.33	2.41	5.53	5.57	2.46	2.76	2.28	39.68
1912	3.57	2.75	5.39	6.57	3.39	4.40	4.87	5.51	4.35	1.77	2.34	1.24	46.15
1913	10.03	1.37	8.21	3.43	1.53	1.03	2.82	1.09	3.70	4.45	3.84	1.67	43.17
1914	1.99	5.66	3.40	3.06	1.20	2.23	1.39	4.67	4.29	3.76	0.88	4.04	36.57
1915	4.71	2.35	1.21	1.14	7.84	6.29	3.31	8.07	3.49	1.57	3.63	8.29	51.36
1916	9.87	1.71	2.07	2.90	2.64	5.91	2.58	7.41	2.00	2.25	1.78	4.45	45.57
1917	5.22	1.49	3.87	7.32	4.72	3.43	4.23	3.57	2.03	2.65	2.23	1.79	42.55
1918	4.96	0.66	1.31	6.85	7.43	2.95	0.90	5.00	4.53	2.67	2.29	6.63	46.18
1919	1.26	1.70	6.26	3.43	6.76	3.77	1.09	3.16	1.64	9.47	6.05	1.85	46.44
1920	4.00	1.08	7.07	2.76	8.60	------	------	------	------	------	------	------	------
Average	4.02	2.66	4.51	4.24	4.24	3.58	3.72	3.62	3.14	3.12	2.91	3.41	43.13

North Fork Drainage Ditch from Big Four Railroad Bridge during high headwater.

Brush Creek near Texas City flooded by backwater from North Fork Ditch headwaters. Top of bridge just seen in middle background.

These excessive storms compare closely with the studies of the Miami Conservancy engineers who made an exhaustive research into rainfall records for most of the country. They predict as follows for the region of the Saline basin:

Storms to the following depth in inches are likely to occur once in

Duration of storm.	15 years.	25 years.	50 years.	100 years.
1 day	4.7	5.5	6.2	6.3
2 days	6.0	6.6	7.8	9.8
3 days	6.4	7.3	8.9	10.4
4 days	6.8	7.5	9.2	10.4
5 days	7.3	7.9	9.4	10.4
6 days	7.9	8.4	9.8	10.7

Excessive storms as shown above have a great effect on the streams in producing a heavy and quick run-off, especially if the ground be already partly or wholly saturated from previous rainfalls; but with or in addition to the excessive rains should also be considered the monthly rainfall over the district in question. For this purpose on Appendix 1 is given a chart showing, first, the rainfall by months for each of the above four stations for the same years as above; second, the average monthly rainfall for the four stations and, third, the averages for each month of the year separately.

Run-off.

Meade, in his book on Hydrology, defines run-off as follows:

> The run-off is that portion of the rainfall that is not absorbed by the deep strata, utilized by vegetation or lost by evaporation, and which finds its way into streams as surface flow. The demands of seepage, vegetation and evaporation are usually first supplied, and the run-off is, therefore, the overflow or excess not needed to supply these demands on the rainfall; or that portion which, on account of topographical conditions, has moved so rapidly that seepage and evaporation have not had time to affect it.

While seepage, evaporation and vegetation are the three prime factors governing the amount of run-off, they are themselves governed by many other factors. The duration of the storm; time elapsed since last storm; the slope of the ground; the nature of the soil and sub-soil; the amount of timber, prairie or cultivated land; the presence or lack of artificial ditches or drainage to carry the water to the streams quickly, all have great effect on the amount of run-off and the speed with which it reaches the stream.

The area of the watershed also has a great effect on the stream. The larger the area, the less likely it is that any excessive storm will cover the entire watershed. For example, in the Illinois River flood of 1904 gauge readings of the stream at various points show the following areas, total discharge and discharge per square mile:

Observation place.	Area square miles.	Total discharge C. F. S.	Discharge per square mile C. F. S.
Joliet	975	22,000	22.5
Devine	6,538	73,000	11.21
Ottawa	10,229	85,000	8.31
Peoria	13,479	90,000	6.68
Havana	17,454	100,000	5.73
Beardstown	23,444	115,000	4.92
Pearl	26,182	117,000	4.47

The above tabulation shows that while we have a run-off of 22.5 c. f. s. on a 975 square mile area, on a 26,000 square mile area in the same storm the run-off was only 4.47 c. f. s. per square mile.

Other flood measurements in Illinois on streams which are approximately similar to the Saline are as follows:

River.	Period.	Area.	Maximum discharge.	C. F. S. per square mile.
Rock at Rockton	1903–09	6,150	27,100	4.41
Fox at Sheridan	1905–06	2,170	9,780	4.51
Kankakee at Momence	1905–06	2,430	6,960	2.86
Big Muddy at Beaucamp Creek	1908–11	735	11,000	14.97
Big Muddy at Pinckneyville	1908–11	227	2,170	9.56
Embarrass at Oakland	1909–11	535	3,650	6.82
Embarrass at St. Marie	1909–11	1,540	6,210	4.00
Kaskaskia at Arcola	1908–11	390	3,870	9.93
Kaskaskia at Shelbyville	1908–11	1,030	10,600	10.29
Kaskaskia at Vandalia	1908–11	1,980	17,720	8.95
Kaskaskia at Carlisle	1908–11	2,680	19,900	7.43
Kaskaskia at New Athens	1907–11	5,220	54,400	10.42
Shoal Creek at Breese	1909–11	760	6,620	8.71
Silver Creek at Lebanon	1908–11	335	4,030	12.03
Skillet Fork, Wayne City	1908–11	481	7,760	16.13
Sangamon at Monticello	1908–11	550	9,280	16.87
Sangamon at Riverton	1908–11	2,560	19,200	7.50
Sangamon at Oakford	1909–11	5,000	11,000	2.20
Sangamon at Taylorville	1908–11	427	4,140	9.70
Salt Creek at Kenney	1908–11	459	5,840	12.72

These nearly all include the period of the great storm of 1910, so that the run-off or discharge here given is much greater than the discharge of ordinary years.

From these tabulations we see that the discharge of Illinois streams very seldom runs above 20 c. f. s. per square mile at any storm period unless it be on a very small watershed and with a very exceptional storm.

Methods of Preventing Floods on the Saline.

To prevent these damaging floods on the Saline there are three methods which might be adopted:

(1) By the construction of an additional outlet or diversion channel.

(2) By slowing up the flood discharge by means of retaining the excess waters in storage basins or reservoirs.

(3) By cleaning, deepening and widening the main Saline and its three principal forks.

(1) *Diversion Channel.*

There is only one possible location for a diversion channel. This would be to excavate a new channel from a point close to Island Ripple bridge, about six miles below Equality, eastward about six miles, and

High back water below Equality. Looking across stream.

Low water in Middle Fork above Equality.

from there, by widening and deepening a small stream for about three miles more, finally reach the Ohio a short distance below Shawneetown. To determine the feasibility of this project a survey was made from Island Ripple bridge east as far as the top of the divide through which

the ditch would have to be cut. This showed that in order to be of much service the ditch would have to be at least 40 to 50 feet deep at the summit. Furthermore, the ground, on the surface at least, is very sandy, which would necessitate very flat slopes and wide top width. Also, the line of the proposed channel is full of isolated hills, and to avoid a long deep cut, or a succession of deep cuts, the line would have to consist of a series of curves. The diversion channel would entail the excavation of at least 2,500,000 cubic yards of material, part of which may be rock, and there would probably be considerable maintenance cost because of the surface being sandy and liable to slough off and into the channel. The cost of excavation, right-of-way, (all being private property and good farm land), bridges, road changes and maintenance, would combine to put this method out of consideration for economical solution of the question.

(2) *Storage Basins.*

The control of flood waters by means of storage basins is fast becoming one of the principal methods of flood prevention, and it is well worth study on the Saline problem. In this type of flood relief the plan is to build low dams in such locations where land is cheap and where a considerable volume of water can be retained without great damage to property. Through the dam is a culvert or open waterway through which a limited amount of water can pass on down stream at all times, and only the excess waters are retained. After the crest of the flood is passed, the retained water also goes down through the culvert until the basin is again empty and ready for the next high water.

This plan is well adapted for control or partial control of waters on the upper reaches of all three forks of the Saline. In that part of the stream liable to backwater from the Ohio the dams, however, would have to be constructed entirely of concrete, or else of earth high enough that no backwater would overtop and thus destroy them. Because of the limited appropriation, no study was made of the location for such storage basins, but the writer is satisfied that especially on the North Fork and on South Fork, suitable locations can be found where large bodies of water can be retained on land costing not more than $20 or $25 per acre.

(3) *Deepening and Widening the Channel.*

This method would be the one most naturally first thought of, and on this most of the time of the survey was spent.

Present Condition.

As stated before, the present condition of the unimproved portions of the Saline is extremely bad in many ways. In the first place, while the drainage ditches are mostly free from brush, drift and debris, the stream below is choked with trees either sunk to the bottom or floating

and blocking the current; the slopes are lined with dead trees, standing or fallen; the stream is tortuous in the extreme, and in many places is narrower than the tributary ditches; the bottom is very fluctuating, deep in some places, shallow in others.

Mouth of North Fork at low water. Middle Fork at left—L. & N. Bridge in background.

Corn field opposite Equality flooded by back water.

The writer would estimate that merely cleaning out the channel free from logs and debris on bottom and slopes would increase the discharge by at least 50 per cent. To cut out the worst of the short bends would increase the discharge still more. For example: a cutoff of a few

hundred feet near the mouth of the South Fork would eliminate about two miles of very crooked stream, thus increasing the fall and velocity, and getting the waters of Saline Creek to the Middle Fork quicker and farther down-stream than at present.

Above Equality these conditions are predominant. Below there it is wider and less obstructed by brush and debris, but in many places rock reefs and bars rise above the normal bed of the river, thus breaking the grade line and, of course, reducing the velocity and discharge. In the lower part of the river, below Island Ripple bridge, the stream passes around or through the eastern end of the Ozark uplift, and the channel is confined between banks from 150 to 250 feet wide, with rock bottom and in some places rock ledges extending up five or six feet on the slopes.

Detailed Surveys.

Detailed surveys were made from Saline Mines Ferry, about twelve miles below Equality, to Gormley or High Bridge, about six miles above the same. Checked lines of levels were run from several U. S. Bench Marks to and along the river. Over most of this territory transit lines were run to locate the river channel and obtain distances along the river. A line of soundings was then taken along the center line of the river, or as near as proved practicable to the center. These soundings were taken each half minute from a motor boat either going up-stream under power, or else while floating down-stream. Notation was made of the time of passing each transit point, and the soundings between points were then located by dividing the distances between points by the number of soundings taken in the same distance. Elevation of the water was obtained from the bench marks left along the shore, and soundings were read from water level to the bottom with a 14 foot pole or a leadline. From these soundings the profile appended herewith was made.

In addition to the profile thus taken, about 100 cross sections were taken between Saline Mines Ferry and Gormley bridge. They were obtained by stretching a line across the river, tagged at each ten feet, and then taking the depth at each tag. The distance between sections was varied by conditions in the river, it being the aim to get sections at or near each end of a reef and as many on the reef as seemed necessary. As in the profile, the elevation of the water was first obtained and then depths were read from that. In general, the elevations obtained by the cross sections closely agreed with the profile soundings. These cross sections are found on the cross section sheet herewith and each section is located by number on the profile sheet.

Result of Soundings.

By means of these soundings and sections, four reefs or bars were found above Equality, which interfere considerably with the flow. Below Equality ten reefs, all of rock, were noted. At Island Ripple bridge, six miles below Equality, a rock reef extends across the stream a foot higher

than the bed of the stream at Equality. Still further down stream were two reefs, one of which extended about half a mile and the other a third of a mile along the river. On the other hand, points were found between reefs where the water was over thirty feet deep.

Island Ripple Bridge during high water.

Water about 1 foot above low stage.

Discharge of the Saline River.

Previously we have seen that the flood discharge of very few streams in a watershed similar to this one has been more than 20 c. f. s. per square mile of area. This means a run-off of about three-quarter inch

per day over the entire area. For the purpose of this report, however, we will raise that limit to 27 c. f. s., or slightly more than one inch run-off. It is, of course, possible that there might be rains which would give more run-off than this, but not over any large area. They would be local and in the nature of a cloudburst. One very exceptional rainfall occurred in this valley in 1918 when, after a heavy storm period in April, another storm on May 11 and 12 gave a rainfall as follows:

Equality	7.09 inches
Shawneetown	5.32 inches
McLeansboro	6.12 inches
New Burnside	8.11 inches
Harrisburg	10.00 inches (said to be)

This would average for the entire watershed 7.33 inches, and the discharge would undoubtedly be considerably greater than 27 c. f. s., but it is so unusual that it would be beyond good engineering to provide for it.

Using this factor of 27 c. f. s. per square mile of area, we find the following probable discharges for the river at various points:

Saline Creek (South Fork), at mouth, area 240 square miles	6,480 c. f. s.
Middle Fork at mouth, 225 square miles	6,075 c. f. s.
Middle Fork below South Fork, 440 square miles	12,555 c. f. s.
North Fork at mouth, 385 square miles	10,395 c. f. s.
Saline, below North Fork	22,950 c. f. s.

Recommendations.

From the observations made and the study given to the question the following recommendations are made:

Middle Fork should be improved from near its crossing of the Big Four Railroad near Muddy to its junction with North Fork. Its worst bends and twists should be eliminated by cutoffs, and in many places it should be widened or deepened, or both. The stream has a fairly good fall and could be easily made to carry a much greater discharge than at present.

According to R. D. Brown, who made a careful survey from Muddy to High bridge, called Gormley bridge in this report, the fall between those points is about 19 feet in a distance of 50,000 feet. This, if uniformly distributed, would give a rate of fall of .038 per 100 feet. Assuming a rate of .035 per cent and a value of .025 for "n" in Kutter's formula, we should have a ditch from Muddy to the mouth of Saline Creek of 65 foot bottom width, with one to one slopes and a depth of 15 feet. This ditch would give a velocity of 5.56 feet per second, and a discharge of 6,672 c. f. s. to carry the discharge figures on a previous page at 6,075 c. f. s. for a 225 square mile area.

From the mouth of Saline Creek to Gormley bridge the same basis of calculating would show that a ditch 100 feet on bottom with depth of 17.5 feet would be necessary. This would give a velocity of 6.34 feet and a discharge of 13,035 c. f. s. against a discharge of 12,555 from the 440 mile area.

Saline Creek (South Fork).

This should be straightened and improved from near Mitchellsville to its mouth. Especially should a new channel be cut near its mouth where a few hundred feet of cutting through low ground would eliminate

High backwater below Island Ripple.

Taking cross section on Island Ripple reef. Water about 1 foot above low stage.

at least two miles of meanderings. By doing this the velocity would be increased, and the crest of the flood would reach the main stream considerably quicker. Also the new mouth being farther down-stream in the Middle Fork than at present would give more chance for the Saline

Creek crest to reach the junction ahead of the Middle Fork crest. The size of the Saline Creek as improved should be the same as Middle Fork, 65 foot bottom, slopes one to one and 15 feet deep. This, with a velocity of 6 feet per second, would yield a discharge of 7,200 c. f. s. against an estimated discharge of 6,480 c. f. s., for an area of 240 square miles.

Below Gormley bridge the fall of the stream decreases and the grade of .015 per cent shown on the profile sheet is used in calculating the size. From this point to the mouth of North Fork the improved stream should be 100 feet on bottom and 22 feet deep, which would give a velocity of 4.88 feet per second and a discharge of 13,098 c. f. s.

North Fork.

North Fork from where it enters Gallatin County near Texas City should be widened, deepened and the worst of the bends eliminated. The stream should be widened to a bottom of 100 feet with a depth of 20 feet. With the same values of "n" and "s" there would be a velocity of 4.60 feet per second and a discharge of 11,040 c. f. s. against the estimated 10,395 from the area of 385 square miles.

The Main Saline.

Below the mouth of North Fork the main river should have a bottom width of 150 feet and a depth of 25 feet. With slopes of one to one, with "n" equal to .025 and "s" equal to .015 per cent, we would have a velocity of 5.40 and a discharge of 23,625 c. f. s. against 22,950 from the three tributaries.

In all of these cases the flood velocity would probably be higher than here given, thus giving a greater discharge and an increased factor of safety. Also the banks of the stream are generally higher than the depth of stream called for. If, however, at any point they are not up to the height called for, the material excavated for widening or deepening could be used to raise the bank in the form of a levee.

On that part of the river from Gormley bridge to Saline Mines Ferry a detailed estimate of the yardage to be excavated was made from a study of the cross sections taken. On the river below North Fork, the excavation all being in rock, and the river being generally wider than called for in the calculations, the estimate was made on the basis of a 100 foot width of the excavated part with sides vertical.

On this basis, from Saline Mines Ferry to the mouth of North Fork would mean the excavation of approximately 170,000 cubic yards, practically all of which is rock. The rock is limestone, in some places coming in solid ledges and in other places fragmentary and loose.

From North Fork to Gormley bridge would involve the excavation of approximately 500,000 cubic yards of earth and about 24,000 cubic yards of rock.

It is further recommended that the entire stream be cleared of all accumulated drift, debris and standing brush.

It is also further recommended that as soon as money is available from additional appropriations this survey be extended to determine the feasibility and location of storage basins on either of the Forks, and to make detailed estimate of cost of the same and of the widening and deepening herein approved.

Credit should be given in this report to Ralph D. Brown, superintendent of the O'Gara Coal Company of Harrisburg, and to A. B. Walter, engineer of the same, for their assistance in furnishing maps, notes and data regarding the Saline from Gormley bridge up stream; to Dr. Gordon, of Equality, and to Honorable K. C. Ronalds of Eldorado, for assistance given.

W. G. POTTER, *Drainage Engineer,*
Division of Waterways.

HISTORICAL DATA

Appended herewith are quotations from a report of R. D. Brown, chief engineer of the O'Gara Coal Company of Harrisburg, as to the condition of the Saline River in Saline County in 1918, and making recommendations for its improvement:

"Agricultural and industrial development of consequence in Saline County may be classed as recent since little was done previous to the opening of the coal fields about 1902-1905. Since that date progress has been rapid. The sale of coal lands from 1902-1906 liquidated the capital assets of the community providing funds for much needed improvements. At that time much of the best agricultural lands of the county were undrained and a menace to the public.

"As rapidly as possible drainage districts were formed and many projects have been carried out, more or less local in their extent, but all profitable and legitimate. One of the first was the Black Land District, just northeast of Harrisburg. Following this many other districts have been formed as shown in the following table:

SALINE COUNTY DRAINAGE DISTRICTS.

District.	Date.	Approximate acreage benefitted.	Outlet.
Black Land	1905	5572	Middle Fork.
Stonefort	1909	2900	South Fork.
Briar Creek	1910	3720	Middle Fork.
West Harrisburg	1911	1758	Middle Fork.
Rector	1910	17130	North Fork.
Middle Fork	1911	10980	Middle Fork.
North Fork	1911	23000	North Fork.
Bankston	1911	8765	Middle Fork.
Eldorado	1911	2176	Middle Fork.
Saline Valley	1913	9740	South Fork.
Black Branch	1915	2670	Middle Fork.
Cottage Grove	(?)	3140	South Fork.

"The various local districts have been formed at the upper end of the watershed where drainage could be obtained at a minimum expense,

and no thought was given to the relation of the various enterprises. In fact, there has been no comprehensive study of the problem as a whole, and the result is the serious flooding of lands in the lower watershed which encroaches seriously on the right of land owners. Not only has serious flooding occurred, but many of the ditches already dug are becoming choked near their outlet from the deposit of silt. Silting is also taking place over the whole area of the lower watershed of the Saline. Reservoirs and river channels are becoming so seriously blocked that immediate steps must be taken to protect farms in the low lands. The velocity attained by flood waters in the unobstructed channels of the drainage ditches has caused considerable erosion of their banks, which in some cases has amounted to an increase in the width of the ditch of from 30 per cent to 50 per cent within a period of three to five years. This scouring would not be so objectionable regardless of the loss of bridge abutments if it were not for the obstruction caused by the silting of the lower end of the ditch near the outlet where the velocity of the flood meets a decided check. Thus it may be seen that an outlet ditch is necessary to protect ditches already constructed and, as said before, the channel of Saline River itself is being gradually reduced by each succeeding flood.

Causes of Floods in Saline County.

"There are two causes for the damaging floods which affect the lower drainage area of Saline River. They may be stated as follows:

First—Recurring intense rainfall within a limited period of time.

Second—The impeded outlet through the low lands for the run-off from the steep, inclined, and rolling watershed.

"The first of these causes is entirely beyond the control of man, but the second may be partly eliminated by applying engineering principles. Referring to table No. 2, showing the rainfall for the vicinity for the past twenty years, it may be seen that storms seem to be increasing in intensity and also in frequency in spite of the fairly even average annual rainfall. Storms with intensive rainfall are not confined to any one season and cannot be predicted. In the month of May, 1918, ten inches of rain fell within a period of 36 hours. This unusual storm followed a period of light rainfall, so that the run-off from the watershed was not relatively as great as may be expected under less favorable conditions. However, the resulting flood produced the highest water since 1913. Ten inches of rainfall in 36 hours is an unusual occurrence, but even greater intensities may be expected.

"However, it is neither necessary for the sake of safety nor imperative from an economic standpoint to provide for the maximum flood expected, and it is good engineering and reasonable practice to take care of the probable average conditions which may occur. The elimination of all floods is desirable, but the cost would be prohibitive.

Length of Water Courses and Calculation of Velocity and Capacities.

"In attempting to calculate the velocity of flow and the amount of run-off of the various contributaries of the Saline River, we must consider many variables. The results are, therefore, based on assumptions which may be greatly in error and it is, therefore, hardly safe to rely on calculations alone, but we may make these calculations and compare the results with records of similar existing enterprises which have passed the experimental stage.

"Your engineer, in searching records of similar operations, has found that in some instances elaborate calculations to minute detail have been made in computing the size of a certain ditch to carry a definite volume of water. These calculations were invariably based on assumptions and premises liable to a variation of even 200 per cent. Under such circumstances undue refinement seems to be uncalled for.

"Referring to the map it is evident that three main ditches form the main tributaries to Saline River. They are Middle Fork, Bankston, and Saline Valley. The calculations of velocities, capacities, and the dimensions of these ditches may prove interesting. They are as follows:

MIDDLE FORK DITCH DATA

Upper station number.	Lower station number.	Bottom width.	Grade.	Calculated velocity ft. per sec.	Capacity when 10′ deep Cu. ft. per sec.
0	249	10	.002	8.4	1680
249	493	15	.002	8.8	2200
493	748	18	.0015	7.7	2250
748	794	25	.0015	8.2	2800

Total length—15 miles.
NOTE.—One station length=100 ft.

BANKSTON DITCH DATA

Upper station number.	Lower station number.	Bottom width.	Grade.	Calculated velocity ft. per sec.	Capacity when 10′ deep cu. ft. per sec.
0	78	6	.10 %	4.	290
78	203	6	.065%	3.1	230
203	260	8	.13 %	4.9	410
260	420	10′	.05 %	3.4	330

Total length Ditch No. 1=8 miles.

SALINE VALLEY DITCH DATA

Upper station number.	Lower station number.	Bottom width.	Grade.	Calculated velocity ft. per sec.	Capacity when 10′ deep cu. ft. per sec.
0	170	25′	.04%	4.1	1400
170	320	25′	.06%	5.1	1800
320	430	30′ (?)	.04%	4.2	1700

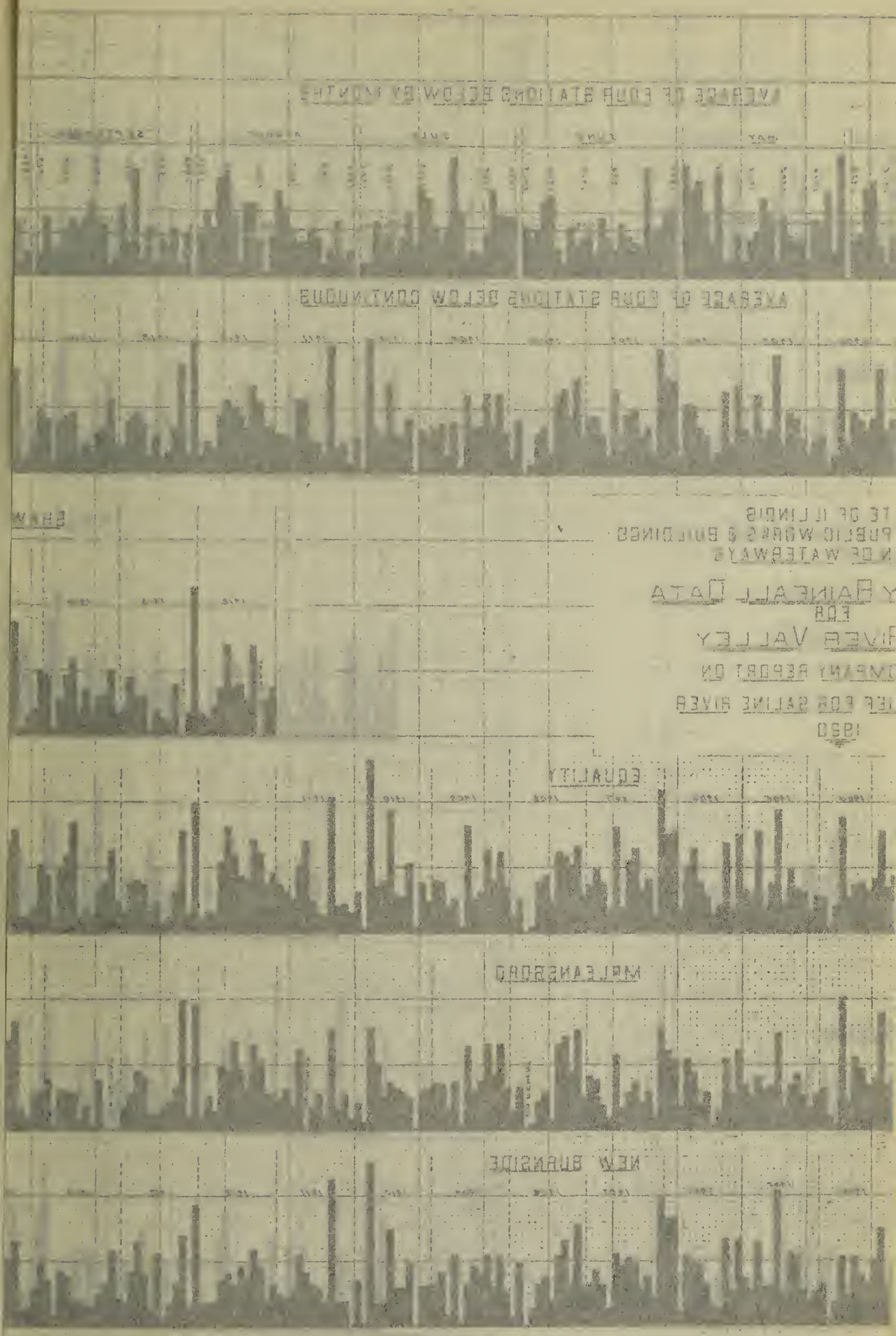
Length of ditch=8.14 miles.

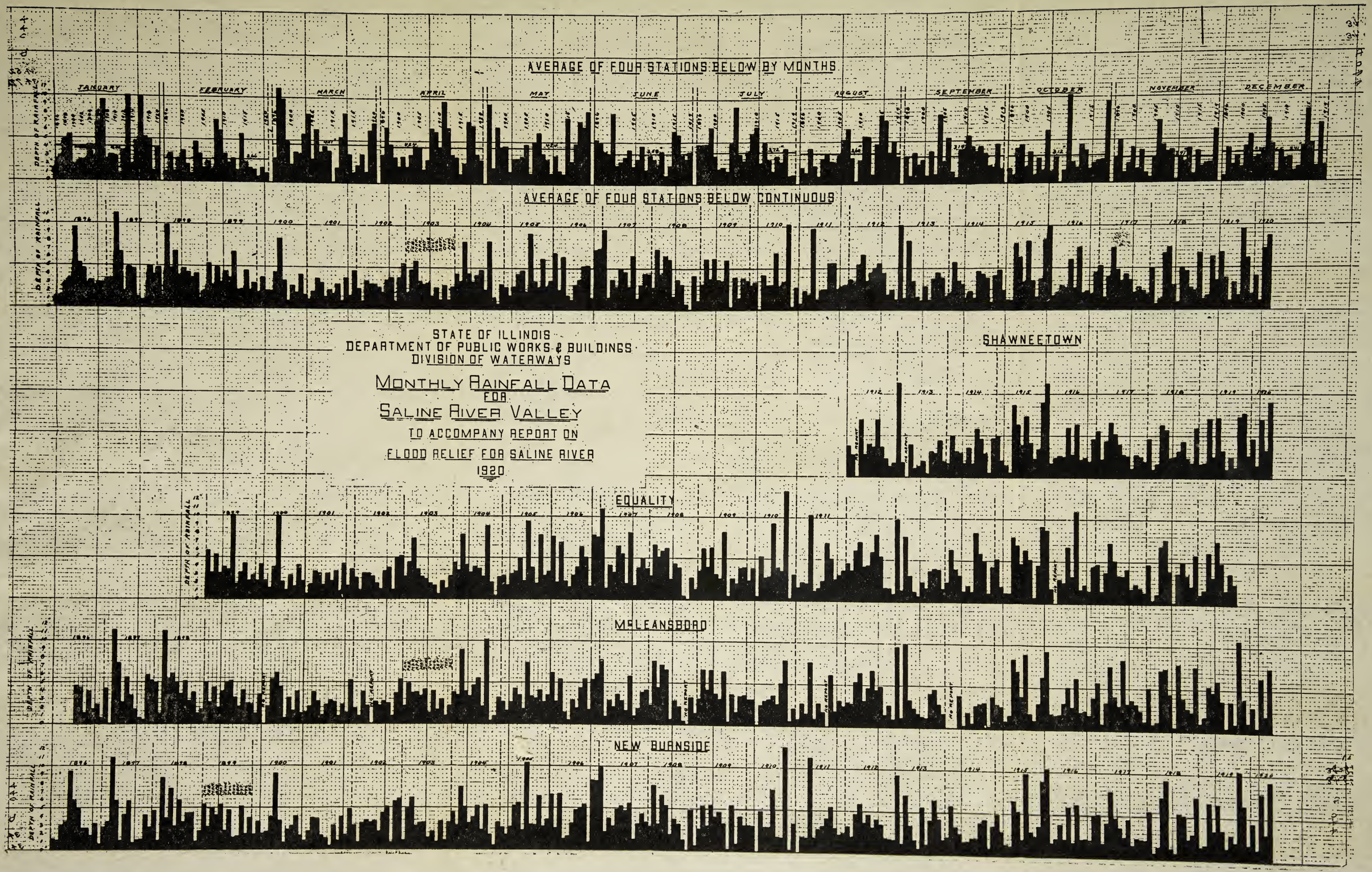
The calculated velocities are probably near the correct velocity for the water running in the ditch under the assumed conditions. When the ditch overflows its banks in the lower sections the velocity is greatly reduced, so that the average velocity of the flood as a whole is probably less than one-half the calculated velocity for the ditch. Assuming that this is true, water contributed to Middle Fork Ditch at the upper end of its watershed would require between 5 and 6 hours to reach Muddy, and the crest of a flood should reach Muddy from 10 to 12 hours after the maximum period of rainfall. This appears to be about the length of time required, as observed from actual flood conditions.

"The Bankston Ditch is somewhat shorter than Middle Fork, but owing to conditions the velocity is much less and, consequently, the flood crest reaches Muddy at about the same time as that from Middle Fork. The Eldorado Ditch, emptying just below Muddy, has approximately the same flood period.

"The combined flood discharge at Muddy for an unusual rainfall of from 3 to 6 inches is from 5,000 to 20,000 sec. ft. The capacity of the ditches tributary at Muddy is about 7,500 sec. ft. without overflow. This volume of water is now conducted to the junction with Saline Creek, a distance of 8.6 miles in the channel of Middle Fork. The obstructions to the flow are many and the velocity probably averages less than one foot per second. The time required by water to travel this distance would be approximately 12 hours.

"Saline Creek drains 165 sq. miles in Johnson and Williamson Counties, the length of the headwaters from the Williamson-Saline County line being 27 miles. From Williamson-Saline County line via the present channel to the junction with Middle Fork is 20 miles, 8.1 miles of this distance being made up by the Saline Valley Ditch. Calculations show that a flood crest in Saline Creek should reach the junction from 36 to 48 hours after the maximum rainfall. The drainage area of Saline Creek above the junction is 260 sq. miles, 65 per cent of this area being very hilly."




STATE OF ILLINOIS
DEPARTMENT OF PUBLIC WORKS & BUILDINGS
DIVISION OF WATERWAYS
MONTHLY RAINFALL DATA
FOR
SALINE RIVER VALLEY
TO ACCOMPANY REPORT ON
FLOOD RELIEF FOR SALINE RIVER
1920
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JANUARY
FEBRUARY
MARCH
APRIL
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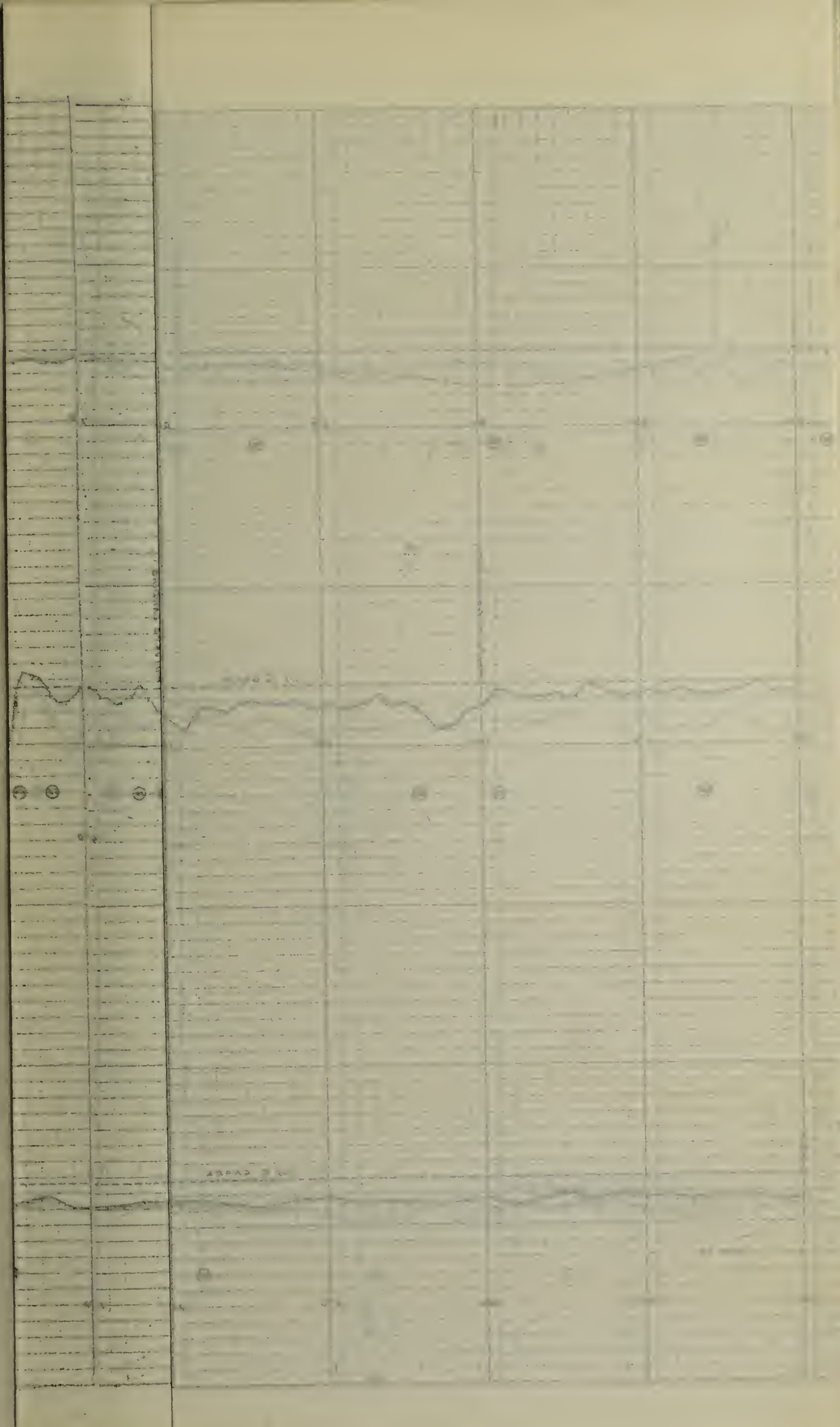

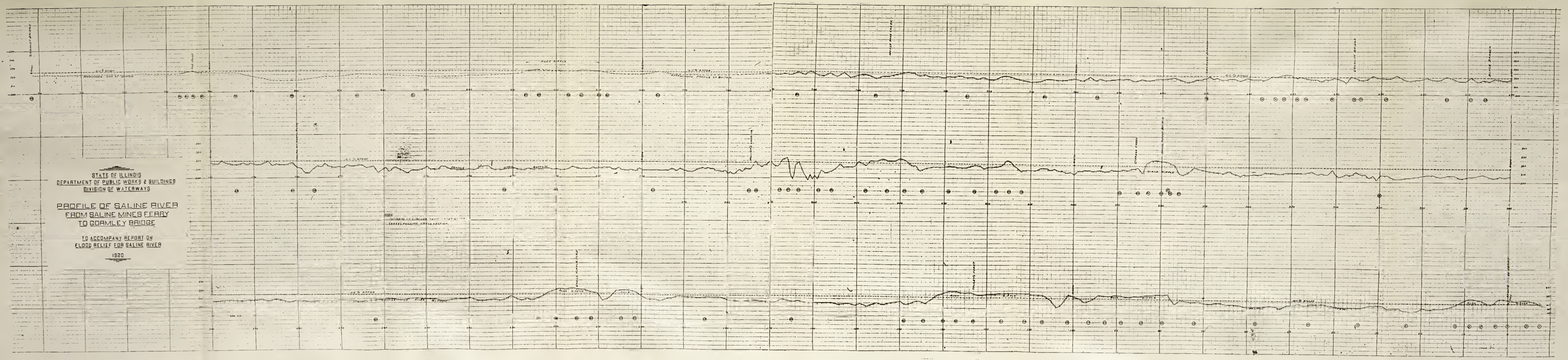
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DEPARTMENT OF PUBLIC WORKS & BUILDINGS
DIVISION OF WATERWAYS
PROFILE OF SALINE RIVER
FROM SALINE MINES FERRY
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TO ACCOMPANY REPORT ON
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1930

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EIGHTH ANNUAL REPORT

OF

DIVISION OF WATERWAYS

OF

THE DEPARTMENT OF PUBLIC WORKS AND BUILDINGS

July 1, 1924

TO

June 30, 1925

C. R. MILLER, Director

WILLIAM L. SACKETT, Superintendent of Waterways

M. G. BARNES, Chief Engineer
Head of Division from December 16, 1924

[Reprinted from the Eighth Administrative Report. Printed by authority of the State of Illinois.]

EIGHTH ANNUAL REPORT

OF

DIVISION OF WATERWAYS

OF

THE DEPARTMENT OF PUBLIC WORKS AND BUILDINGS

July 1, 1924

TO

June 30, 1925

1924

NATURAL HISTORY SURVEY LIBRARY

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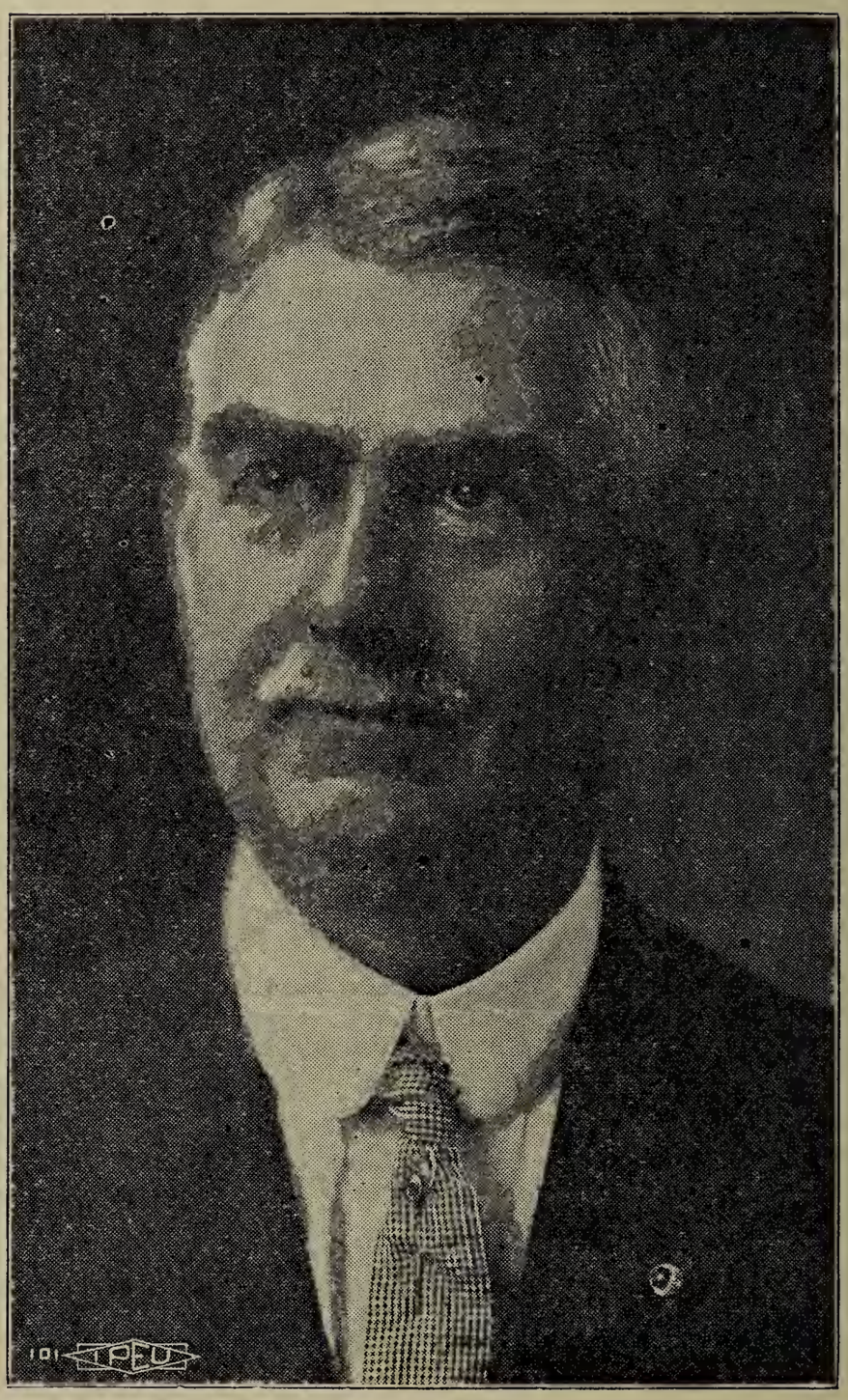
William Loren Sackett



May 21st, 1866 December 16th, 1924

The Honorable William Loren Sackett died at 1:15 o'clock in the morning of December 16th, 1924, of pulmonary embolus, following an operation on November 21st.

Mr. Sackett's loyalty and untiring devotion to waterways and the State's interest and duty to the people in protecting public waters from encroachment and pollution, and in furthering the development and early completion of the Illinois Waterway won for him the admiration and respect of all factions. This together with his genial disposition, courtesy and unfailing consideration for his subordinates endeared him to all of his associates in the Division of Waterways. He was considered one of the leading authorities in the State in waterway development problems, and was one of the leading spirits behind the Lakes to Gulf Waterway development, which he advocated wholeheartedly during his entire administration of office.

Mr. Sackett was appointed Chief Clerk and Pay Master of the Illinois & Michigan Canal by Governor Tanner in 1897, and was appointed Canal Commissioner in 1902 by Governor Yates. His services as Commissioner continued until 1913 when Governor Dunne appointed a Democrat, but Mr. Sackett was reappointed by Governor Lowden, and succeeded to the office of Superintendent of Waterways in July, 1917, when the present Civil Administrative Code organizing the Division of Waterways came into effect. Mr. Sackett held the position of Superintendent of Waterways through the Lowden administration and Governor Small's administration until his death.

DIVISION OF WATERWAYS.

M. G. Barnes, *Chief Engineer.*
Head of Division December 16, 1924 to June 30, 1925.

I have the honor to submit the following report of the Division of Waterways for the year July 1, 1924 to June 30, 1925.

It is with a feeling of sadness that we introduce the Eighth Annual Report. The Honorable William L. Sackett died at 1:15 o'clock in the morning of December 16th, 1924, after a continuous service of 7 years 5 months and 15 days as Superintendent of Waterways.

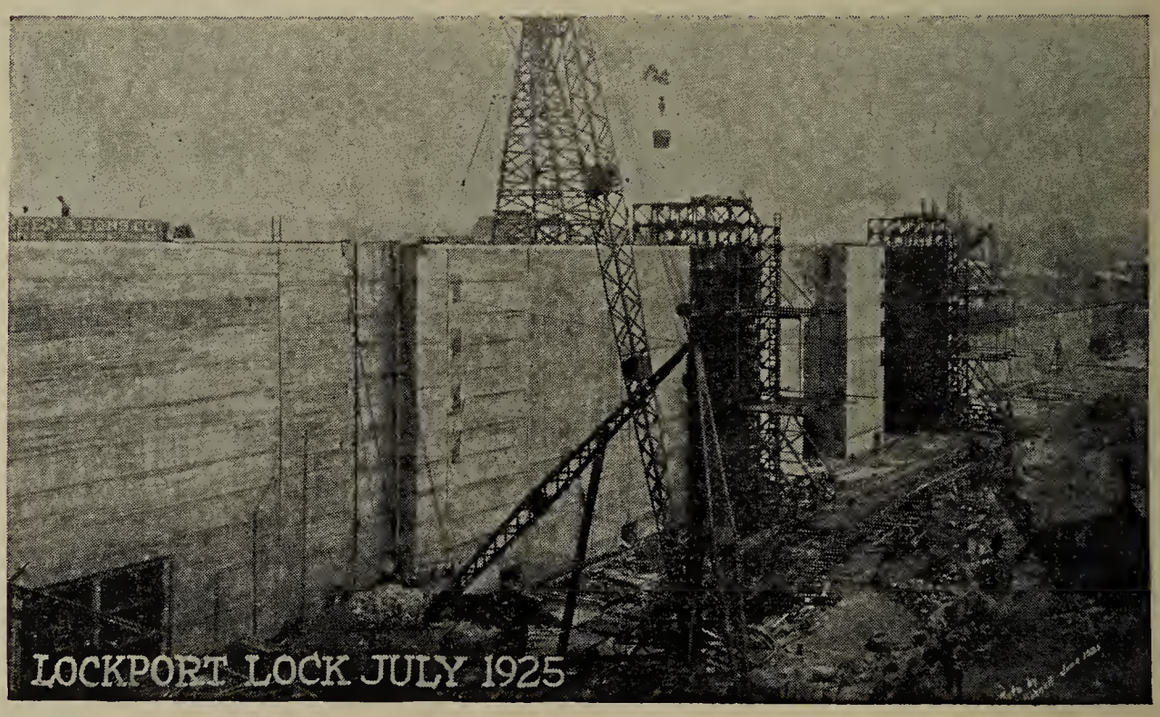
Since Mr. Sackett's death the work of the Division of Waterways has been in charge of the engineering force. The report that follows is made by the joint efforts of the Engineers in the Division.

Construction work on the Illinois Waterway has been confined to the work under contract with Green and Sons Company for construction of the lock walls and upper gates and valves for the Lockport lock, located at the upper terminal of the Illinois Waterway and adjacent to the Chicago Sanitary Canal Lock. This lock connects the sanitary canal and Lake Michigan with the DesPlaines River at Lockport and has a lift of about forty-one feet when no water is running in the sanitary canal. The details of the work performed by this contractor are set forth quite clearly by Division Engineer J. B. Bassett in his report, which see.

An excellent foundation on limestone rock has been encountered for this structure. However, a few large clay pot holes were encountered which require an extra amount of excavation and concrete. The concrete being used in this structure is of rather a rich mixture, so designed to prevent deterioration from the sewage contained in the sanitary canal which, experience has shown, has a bad effect on concrete in contact with it, especially near the freezing line. The State has been fortunate in securing a natural bank run of gravel which contains in almost ideal proportions, sand and gravel, from silt to pebbles of from two inches to three inches in diameter. Tests have shown this gravel to be unusually dense and of a weight in excess of that usually encountered for concrete purposes. The cement used is manufactured at the Buffington plant and is furnished to the contractor by the State. From 1.1 to 1.3 barrels per yard of concrete are being used. The resulting mixture shows a very dense and pleasing appearance and it is believed will successfully resist the action of this sewage-charged water and the elements.

The Lockport lock will have a usable length of 600 feet. This seems to be longer than the engineers who laid out the sanitary canal had anticipated would be constructed at this place. The State was, therefore, cramped in space for this structure. As a consequence it seemed desirable to substitute a lift gate for the standard miter type. Two such lift gates are being constructed in this lock and so designed that one may be used to hold back the upper pool level while the operating gate is being examined, repaired and painted. The Division of Waterways is conducting a long series of tests to determine the best

LOCKPORT LOCK.
Progress to October 27, 1924.



paint to be used on these lock gates. It has already been found that paints usually used for this purpose fail within a few months after being placed in contact with the sanitary canal water.

The work for the contractor, Green & Sons, Co. of Chicago is being carried on under the supervision of Mr. Roy Shackleton, Superintendent, and Mr. Ralph Bonnell Engineer. Mr. R. S. Heath, Resident Engineer, is in charge for the State. Thirty-five per cent of this contract was completed at the end of this fiscal year.

The Ottawa Division Office has been employed in making surveys and platting land to be required for right of way purposes, supervising construction work on the Illinois Waterway and also supervising the construction of bridges and the repair of the Illinois and Michigan Canal.

At the Chicago office very little engineering work has been done on the Illinois Waterway project. What has been done has been confined quite largely to routine work and to detailed plans of work under construction.

At the beginning of this fiscal year the designing force consisted of one Chief Designing Engineer, two Assistant Engineers and two draftsmen. One Assistant Engineer was transferred to the field on August 1, 1924, and one of the draftsmtn resigned to accept a better position on September 1. The remaining force was called upon much of the time for detail on work not connected with the Illinois Waterway. Approximately one-third of the time of the force was thus occupied. A detailed account of engineering activities of this designing force will be found in the report, of Walter M. Smith Chief Designing Engineer.

In an effort to acquire right of way and land to be used in the construction of the lock and dam at or near Utica at what is known as the Starved Rock lock site, it is found necessary to appeal to the courts in condemnation proceedings to acquire land from Otto W. Engel. The decision of the lower court in LaSalle County was not satisfactory to the Department of Public Works and Buildings, nor to the Attorney General. Consequently an appeal was taken to the Supreme Court. The decision of the higher court was not handed down until January 1925, The Supreme Court reversed the lower court on the points that were embarrassing to the State in prosecuting the construction of the Illinois Waterway. The Illinois Waterway Act has now been interpreted by the highest court and the State is in position to secure the necessary lands for canal purposes by condemnation if they cannot be acquired otherwise. The decision of the Supreme Court made a part of this report.

DOCKET NO. 15502—AGENDA 73—JUNE, 1923.

THE DEPARTMENT OF PUBLIC WORKS AND BUILDINGS, *Appellant*,

v.

OTTO W. ENGEL, *et al.*, *Appellees*.

Mr. Chief Justice Duncan delivered the opinion of the court:

The Department of Public Works and Buildings, for the use of the People of the State of Illinois, on January 18, 1923, filed a petition in the county court of LaSalle County to ascertain the just compensation for, and

to condemn, approximately thirty-eight acres of land situated in Utica township, LaSalle County, to be used in the construction of the Illinois waterway, as provided for in an act of the General Assembly in force July 1, 1919, entitled "An act in relation to the construction, operation and maintenance of a deep waterway from the water power plant of the Sanitary District of Chicago at or near Lockport, to a point in the Illinois River at or near Utica, and for the development and utilization of the water power thereof." (Laws of 1919, p. 978.) The land was to be used by appellant in connection with the construction of a power plant and lock and dam across the Illinois River near Utica as a part of the waterway. Appellees, Otto W. Engel, Oscar Haeberle, (successor in trust to Charles E. Hook, trustee), J. S. Watters and B. S. Harrison, and the unknown owners and unknown persons interested in the premises sought to be taken, were made defendants to the petition. The petition contained the usual allegations as to the necessity for the taking of the premises for the purposes aforesaid. The defendants traversed the allegations of the petition or challenged by certain objections the claim that the premises were necessary for those purposes. Engel and Haeberle, successor in trust to Charles E. Hook, severally filed eighteen objections, all of which were substantially the same. Watters and Harrison jointly filed the same objections as those aforesaid. Engel filed a further objection, numbered 19, to the effect that on September 23, 1920, he and his wife entered into a contract with the Department of Public Works and Buildings whereby the petitioner acquired an option for the purchase of the premises, providing that on payment to him and his wife of the sum of $11,319 they would convey the premises to the petitioner. On March 26, 1923, on a hearing of the objections, the court dismissed the petition. This appeal is prosecuted by the petitioner.

Before any evidence was heard on the objections appellant moved that the court first hear evidence on the question of ownership of the land involved, alleging as a reason therefor that it might appear that one or more of the appellees who had filed objections had sold his or their interests in the property since the petition was filed, and for that reason would have no interest in the property that would permit the interposing of objections. The court overruled the motion, but at the conclusion of the hearing on the objections found that the title to the land at the time the petition was filed was in Engel. The evidence disclosed on this question that Engel had, after the petition was filed and before the hearing, made a deed to the land to Watters and Harrison. Appellant's contention that the trial court erred in overruling its motion to hear further evidence on the question of title cannot be sustained. In a condemnation proceeding the rights of the parties are fixed at the time the petition is filed. Engel had the right to file legal objections, and to be heard on them, irrespective of the question whether or not he had conveyed the land after the petition was filed. Such a conveyance would affect only the question as to whom the compensation should be paid, but not the question whether or not the party making the conveyance was entitled to be heard. *City of Chicago* v. *Collins*, 302 Ill. 270; *Dowie* v. *Chicago, Waukegan & North Shore Railway Co.*, 214 id. 49; *Chicago, Evanston & Lake Shore Railroad Co.* v. *Catholic Bishop*, 119 id. 525.

Of the eighteen objections filed by the objectors, the first eight raised the question of the constitutionality of the act entitled "An Act in relation to the construction, operation and maintenance of a deep waterway from the water power plant of the Sanitary District of Chicago at or near Lockport, to a point in the Illinois River at or near Utica, and for the development and utilization of the water power thereof," approved June 17, 1919,—the act under which appellant claims the right of condemnation in this case. These objections were afterwards withdrawn, and on motion of appellant objections 10 and 11 were stricken from the files. Objection 9 is, in substance, that the taking of the land is not necessary to the construction of the waterway and that the taking thereof is wholly excessive. Objection 15 is to the effect that the land described in the petition is servient to the

other portions of the farm, and that unless and until the plans and specifications for the construction of the waterway are presented to the court and filed in this proceeding the defendants will not be advised as to what damage, if any, will be caused to the land that is either taken or not taken from the farm. Objection 16 is that the land described in the petition is servient to the other portions of the farm, and that unless and until the petitioner presents to the court and files in the cause plans and specifications under which the public improvement is to be made, approved by the Secretary of War, the chief of engineers of the United States, and also approved in accordance with section 17 of the act under which this proceeding to condemn is brought, appellees will be unable to make or file any claim or claims for damages of any kind, either to land taken or not taken. Objection 17 is that no necessity exists for the taking of the land for the purpose aforesaid, for the reason that the route of the waterway from the water power plant of the Sanitary District of Chicago at or near Lockport to a point in the Illinois River at or near Utica has never been fixed or located either by a legislative act or by the Department of Public Works and Buildings. Objection 18 is that appellant and Engel agreed upon compensation for the land, and that appellant had full power and authority to agree upon the compensation and that Engel was under no legal disability at the time he made the agreement with appellant. Objection 19 sets up the option or contract by which the agreement was made that is referred to in objection 18, which option contract has already been stated.

In the view that we take of the case it is only necessary at this time to pass specifically and fully upon the three remaining objections filed by the objectors. Objection 12 is in substance the following: That the land described in the petition is located on or near the Illinois River at or near Utica; that the Illinois River at said land is a navigable river of the United States; that no dam, lock or other obstructions may be placed in that river until the plans and specifications for the same and for all other obstructions and accessory works, together with drawings, maps and surveys thereof, have been submitted to and approved by the Secretary of War and the chief of engineers; that in the construction, maintenance, operation or repair of the waterway and its appurtenances, as specified in the petition, it is and will be necessary to erect, construct and maintain dams, locks and other obstructions, together with accessory works, in the river at said point and elsewhere; that it is not necessary to take said land for the construction, maintenance, operation or repair specified in the petition until the maps, plans, specifications and surveys therefor, approved by the Secretary of War and the Chief of Engineers, have been filed in the proceeding. Objection 14, so far as it is related to objection 12, is, that the necessity for taking or damaging the land described in the petition for the construction, maintenance, operation or repair of a waterway and its appurtenances, as specified in the petition, cannot be determined by the defendants or by the court unless and until the petitioner presents to this court, and files, plans and specifications of the public improvement to be made, approved by the Secretary of War and the chief of engineers of the United States, and it alleges that appellant has not complied with such conditions. The issue made upon these two objections is a preliminary one to be decided by the court, and the burden is upon the petitioner to prove that it has complied with the conditions set forth in these objections, if they are legal objections that must be sustained. *City of Chicago* v. *Lehmann*, 262 Ill. 468; *O'Hare* v. *Chicago, Madison & Northern Railroad Co.*, 139 id. 151.

Appellant offered evidence that the land to be taken was to be used for the location of a lock and an embankment to retain the head waters in the upper pool at this lock, for the location of a highway, for the disposition of the spoils taken from the excavation for the lock and dam and the headworks for the power plant, and for the location of residences for the attendants at the water power plant, the lock and dam, and of other buildings, and that this lock, dam, power plant, etc., were to be erected as a

part of the waterway authorized by the Waterway Act. Section 7 of that act grants appellant the right of eminent domain in the following language:

"Sec. 7. Subject to the conditions and limitations prescribed by this act, and subject to any conditions and limitations which the Federal government or the officers thereof may lawfully impose, the Department of Public Works and Buildings shall have power: * * *

"(8) To acquire by condemnation under the eminent domain laws of this State all property necessary to be taken or damages for the construction, maintenance, operation or repair of the waterway and its appurtenances."

Several laws have been passed by Congress prohibiting obstructions in the navigable waters of the United States without the consent of Congress and the approval of the plans for such obstructions by the Chief of Engineers and the Secretary of War of the United States. Section 9 of the act of March 3, 1899, passed by Congress, provides as follows: "It shall not be lawful to construct or commence the construction of any bridge, dam, dike or causeway over or in any * * * navigable river or other navigable water of the United States until the consent of Congress to the building of such structure shall have been obtained and until the plans for the same shall have been submitted to and approved by the chief of engineers and by the Secretary of War: Provided, that such structures may be built under authority of the legislature of a State across rivers and other waterways the navigable portions of which lie wholly within the limits of a single State, provided the location and plans thereof are submitted to and approved by the chief of engineers and by the Secretary of War before construction is commenced: And Provided, Further, that when plans for any bridge or other structure have been approved by the chief of engineers and by the Secretary of War, it shall not be lawful to deviate from such plans, either before or after completion of the structure, unless the modification of said plans has previously been submitted to and have received the approval of the chief of engineers and of the Secretary of War." (10 U. S. Comp. Stat. 1916, sec. 9971.*

The pertinent provision of the Federal Water Power act passed by Congress June 10, 1920, is as follows: "The commission is hereby authorized and empowered * * * (d) to issue licenses * * * to any State or municipality for the purpose of constructing, operating and maintaining dams, water conduits, reservoirs, power houses, transmission lines, or other project works necessary or convenient for the development and improvement of navigation and for the development, transmission and utilization of power across, along, from or in any of the navigable waters of the United States: * * * Provided further, that no license affecting the navigable capacity of any navigable waters of the United States shall be issued until the plans of the same or other structures affecting the navigation have been approved by the chief of engineers and the Secretary of War." (3 U. S. Comp. Stat. 1925, sec. 9992¼c.)

The effect of this legislation is to make the erection of any structure in a navigable river within the State depend upon the assent of both the Federal and the State governments. (*Cummings* v. *City of Chicago*, 188 U. S. 410, 23 Sup. Ct. 472.) The Illinois Waterway act, in section 7, gives the Department of Public Works and Buildings authority to make application to the Federal government for all necessary permits. There can be no question (appellant admits it) that it will be necessary that the plans and specifications of the works to be erected at the location of the land described in the petition be submitted to and approved by the chief of engineers and the Secretary of War of the United States before the work of construction is commenced. The act under which appellant is acting recognizes that fact and that the Illinois River is a navigable river.

In the case of *Minnesota Canal and Power Co.* v. *Pratt*, 101 Minn. 197, 112 N. W. 395, the identical question now before us was presented to the Supreme Court of Minnesota. In that case a public utility company was authorized by the State to exercise the power of eminent domain in aid

of an enterprise which required the construction of dams, locks, etc., in navigable waters within that State. The company undertook to condemn land to be used in connection with this project and filed its petition, which showed that the consent had not been obtained of the chief of engineers and the Secretary of War to the obstruction of the navigable waters involved. The court held that the petitioner could not exercise the right of eminent domain in furtherance of an enterprise involving an interference with navigable waters within the State without having first procured the approval of its plans by the Federal authorities.

Appellant relies upon the cases decided by this court holding that it is not necessary for a railroad company to obtain the consent of a city to the construction of a railroad in its streets and alleys before the company can condemn property for the construction of the road. Those cases are to be, and must be, distinguished from the one now before us, in that the authority to build a railroad through a city is obtained wholly from the State and not from the city. It is necessary to get the consent of the city to locate the tracks in its streets, but such consent amounts to a license to use the streets and does not give the company any additional right or power to build a railroad. This court has decided that the power to change, alter or obstruct navigable streams over which Congress has assumed jurisdiction is not acquired until the consent of the Federal government thereto is obtained, and that whether or not such consent is obtained is not merely a question between the Federal government and the party erecting such structure or making the change in a navigable river, but it is a question that one whose property is affected may interpose. (*City of Chicago* v. *Law*, 144 Ill. 569.) As it requires in this case both the consent and authority of the State and the Federal governments to construct and place an obstruction in the Illinois River, we must hold that such right and power have not been obtained by appellant, and will not be obtained until consent and authority are obtained from both the State and Federal governments. Appellant having failed to show such authority and consent from the governments the court properly dismissed its petition on that ground.

Objection 13 and part of objection 14 raise the question whether or not appellant may condemn property to be used in connection with the waterway before the plans and specifications therefor have been perfected and submitted to the cities and villages along the line of the waterway and approved by them, as provided by section 17 of the Waterway act. That section provides that when the plans and specifications for the construction of the waterway and its appurtenances shall have been perfected they shall be submitted to the city councils and village boards of the respective cities and villages along the line of the waterway before any work or construction is commenced; that if no objections are filed with the Department of Public Works and Buildings within thirty days after such filing the construction work shall be prosecuted in accordance with the plans and specifications filed; that if within such time any city council or village board files objections thereto, in writing, with the Department of Public Works and Buildings on the ground that the plans and specifications do not (a) provide for proper and adequate protection of such city or village against damage from overflow or flood waters; or (b) do not provide adequately for the altering, re-building or re-constructing of drainage or sewer systems or other public works or bridges and approaches which will be destroyed or materially interfered with by such improvement; or (c) do not provide for the proper location of a public landing place, in case the Department of Public Works and Buildings shall, in its discretion, provide for a public landing in such city or village; then the Department of Public Works and Buildings shall amicably adjust any difference that may exist to the satisfaction of all parties. The section then further provides, in substance, that if the parties cannot amicably adjust their differences such differences are to be settled by a board of arbitration. The act provides for the selection of an arbitration board, and that the plans and specifications finally approved by a majority of such board shall be the

plans and specifications in accordance with which such work shall be constructed.

Under the provisions of Section 17 it is not within the right or power of any city or village to prevent the construction of the waterway and its appurtenances or any part thereof. The act does not even require the consent of any city or village, or a license therefrom, to construct the waterway and its appurtenances, but appellant is authorized to construct the same along or at any city in accordance with the original plans or with the plans finally approved by the board of arbitration. In other words, the right or authority to construct the waterway according to any plans or specifications comes entirely from the State and Federal governments and in accordance with the legislation enacted by the State and by Congress, respectively. This court has frequently held that while a railroad corporation must have the consent of a city council to cross one of its public streets, and the consent of such city council and of the owners of property representing more than one-half of the frontage along any public street to pass through the public streets of any city, still the obtaining of such consent is not a condition precedent to a condemnation proceeding by the railroad corporation, as such consent can be obtained after the condemnation as well as before. *Suburban Railroad Co.* v. *Metropolitan Elevated Railroad Co.*, 193 Ill. 217; *Chicago, Burlington and Quincy Railroad Co.* v. *Abens*, 306 id. 69.) Under those rulings the court should have overruled these two objections.

As to objection 16, appellees would under the same be entitled to have appellant present and file the plans and specifications for the construction of the waterway and its appurtenances after such plans and specifications had been approved by the government authorities but such plans and specifications should be limited to the portion of the waterway the construction of which will affect the land sought to be condemned. No land owner whose land is to be condemned would be entitled to plans and specifications of the entire route of the waterway or of any portion thereof not directly affecting or bearing upon the question of damages to the land taken and land adjoining that taken and belonging to such owner.

Objection 17 should have been overruled by the court. The Waterway act has in sections 1 and 2 prescribed the route of the waterway. No changes are to be made in this route except by the Department of Public Works and Buildings, which is granted authority by the act to deviate from the route specified in the act if in its judgment the utilization of sections of the Illinois and DesPlaines rivers is not practicable or feasible. Appellant will have the option to proceed to construct the waterway on the route named in the act unless it should elect to make the changes designated by the statute after it has obtained the proper consent and authority of the governmental authorities.

Objections 18 and 19 should have been overruled. The option contract and agreement were mutually abandoned by both parties by consent. Appellant finally notified Engel that it would not take the land and pay $300 an acre for it, and it offered to submit the question as to what amount should be paid for the land to arbitration. Engel refused to do this. He finally inquired of the Department if it was going to take the land at the price named in the option, and was informed, in substance, that it would not do so. Engel then said he wanted to sell the land, and informed appellant that the State could get it from the purchaser as well as from him. A short while thereafter he sold and deeded the land to Watters and Harrison, and no mention of the option contract was made in his contract with them.

For the reasons aforesaid the court properly sustained objection 12 and the first part of objection 14.

The order of the court dismissing the petition is affirmed.

Order affirmed.

After the decision of the Supreme Court in this case condemnation proceedings were brought before the Circuit Court of LaSalle County

and the land acquired at a price of $200.00 per acre. This clears the way for the construction of the Starved Rock lock and dam except for an agreement with the city of Ottawa as to damages resulting from the construction of these structures. Negotiations have been carried on with the city authorities for several years, and June 25, 1924 the city of Ottawa appointed Mr. W. S. Richmond consulting engineer as its representative to negotiate with the states engineering representative in arriving at a plan for the protection of the city's public property that will be satisfactory both to the State and to the city authorities. These negotiations are nearing completion and it is believed that a final decision will be reached in a very short time. These negotiations indicate that very little damage will result to public property from the construction of the Starved Rock lock and dam.

At the city of Joliet a much more complicated condition exists because of the construction of the Brandon Road lock and dam just south of the Joliet city limits. These structures will raise the water at the city limits about thirty feet, requiring retaining walls on each side of the waterway throughout the city. The city has appointed an engineering advisory board of five engineers to study the State's plans. Negotiations have been conducted with this board almost continuously during this fiscal year. Plans were submitted to the city for the construction of the retaining walls under date of April 16, 1923. These plans were not approved because (1) the bridge approaches were fixed at 7 per cent whereas the city demand a 5 per cent approach grade (2) specifications did not accompany the plans. Specifications were not printed at the time the plans were submitted and it was so stated in submitting the plans. These specifications have since been printed and the State will acquiesce in the demand of the city for 5 per cent grade at the bridge approaches, and therefore it is felt that the plans will be promptly approved when re-submitted. This will permit the construction of the retaining walls, five highway bridges, the tunnel under the river to be used for public utilities and the re-laying and connection of sewers and water pipes made necessary by waterway construction in the city of Joliet. The land on which the lock and dam at Brandon Road is to be located is owned by private interests. This land must be acquired before the water can be raised to its new elevation.

WATERWAY LEGISLATION.

A Bill, S 4428, Sixty-seventh Congress, Fourth Session, was introduced in Congress by the late Senator Medill McCormick, providing for the diversion of water from Lake Michigan for sanitary purposes and for the improvement of navigation on the Illinois and Mississippi Rivers.

Following the introduction of this bill, Senate Resolution 411 was passed. This resolution authorized the President of the Senate to appoint a Committee of five members of the Senate to investigate matters covered by the bill, and to hold hearings for that purpose. The Committee appointed consisted of the following:

Hon. Medill McCormick, Illinois, Chairman.
Hon. Smith W. Brookhart of Iowa.
Hon. Kenneth McKellar of Tennessee.

Hon. David A. Reed of Pennsylvania.

Hon. Edwin S. Broussard of Louisiana.

Hearings were held at Chicago, Joliet, Peoria and Beardstown in Illinois and at St. Louis, Memphis, New Orleans and Washington, D. C. All data and testimony submitted at these hearings has been published in the report of the Committee, which consists of two volumes under the title "Hearings before the Select Committee on Nine-foot Channel from the Great Lakes to the Gulf." United States Senate Vol. 1, Sixty-seventh Congress, Fourth Session Vol. 2, Sixty-eighth Congress, Second Session.

In the Sixty-eighth Congress, First Session, bills covering the improvement for navigation of the Illinois River and diversion of water from Lake Michigan were introduced by members of Congress from Illinois, as folows:

H.R. 5475 by William E. Hull, Rep. 16th District.

H.R. 6822 by Henry T. Rainey, Dem. 20th District.

H.R. 6873 by M. A. Michaelson, Rep. 7th District.

H.R. 7044 by Martin B. Madden, Rep. 1st District.

The two latter bills covered only the diversion for sanitary purposes.

None of these bills were satisfactory to State officials, nor to all of the Illinois Delegation in Congress, nor to the Rivers and Harbors Committee of the House of Representatives. This Committee then proceeded to hold *Hearings* on the suject of *The Improvement of the Illinois and Mississippi Rivers, and the Diversion of Water from Lake Michigan into the Illinois River.* Hearings were held in Washington in March, April and May, 1924, and all proponents and opponents of the various features covered by the bills had an opportunity to submit their views to the Committee. The opportunity was not neglected and the evidence and testimony presented has been published by the Government Printing Office in the two volumes under the title before mentioned. This report contains a great deal of very valuable data and consists of 2136 pages of printed matter as well as cuts, plans and tables.

In the Sixty-eighth Congress, Second Session, Congressmen Hull and Rainey collaborated in the preparation of H. R. 11371 which bill was introduced by the Hon. Wiliam E. Hull. The bill proposed the impounding and regulation of waters of Lake Michigan, Lake Huron and Lake Erie, so that through the vast pondage area of these lakes the outflow may be regulated to nearly a uniform discharge and their levels increased to beyond what they were before any diversion took place. This increase in lake stages will overcome all objections from the navigation interests of the Great Lakes. The regulated discharge will add enormously to the value of the power at Niagara Falls and along the St. Lawrence River when developed, and should satisfy these objecting interests. The bill proposed that Ilinois, through the Chicago Sanitary District, shall defray part of the expenses of regulating the Great Lakes. Other provisions of the bill were:

(a) Authorization of the amount of water then being diverted (about 8,500 c.f.s.) but not to exceed 10,000 c.f.s., and as sewage purification works were completed to be eventually reduced so as not to exceed 7,500 cubic feet per second.

(b) Required the Sanitary District of Chicago to complete their sewage purification works within 10 years, subject to an additional ten years extension of time if granted by the Secretary of War.

(c) Provided for the appointment by the President of the United States of a commssion of five to determine the amount of and arrange for the settlement of damage claims against the Sanitary District of Chicago on account of their diversion of water from Lake Michigan into the Illinois River.

(d) Provided for federal aid for the construction of flood-control works and levees upon any part of the Illinois River.

(e) Placed the control of diversion of water from Lake Michigan under the Secretary of War and Chief of Engineers.

This bill as a whole is not approved of by State officials charged with waterway matters. No action was taken on this bill owing to more pressing legislation during the short session of Congress.

The major legal difficulty seems now to have been cleared away and it is time to turn our thought to the final completion of the waterway and also to prepare for the installation of power plants and for provision for terminals and docks along the waterway so that its greatest usefulness may be realized. The decision of the United States Supreme Court on January 5, 1925, in the case of the United States vs. the Sanitary District of Chicago, holds that the diversion from Lake Michigan shall be reduced to 4,167 c.f.s., but that a greater amount may be permitted temporarily by the Secretary of War. Secretary Weeks has granted a permit for the diversion of 8,500 c.f.s., for a period of five years, this to be progressively decreased as Chicago's sewage treatment plants are completed. Federal authorities make the amount of diversion from Lake Michigan uncertain and brings to the front the necessity for prompt action by the State in securing an act of Congress fixing the amount of the diversion from Lake Michigan at Chicago that may be used for navigation and sanitary purposes. Every effort should be made by the Mississippi valley interests during the coming session of Congress to obtain a settlement of this very important question for all time. It is pertinent at this time to republish an article by the writer, published in the Sixth Annual Report, and dealing with the diversion from Lake Michigan. That report follows:

DIVERSION OF WATER FROM LAKE MICHIGAN.

By M. G. Barnes, *Chief Engineer, Division of Waterways.*
Prepared for Sixth Annual Report, 1922-1923.
Revised for Eighth Annual Report, 1924-1925.

I again invite your attention to the unsettled condition of affairs relating to the diversion of water from Lake Michigan. Until this question is settled and the future diversion of water known, the State cannot intelligently complete its plans for the Illinois Waterway and water power, nor can the work be completed economically.

The State law, under which the Chicago Sanitary District acts, calls for a diversion from Lake Michigan into the Illinois River, which, with the present population within the Chicago Sanitary District would exceed 10,000 cubic feet per second. The permit issued by the Secretary of War at about the time of the opening of the sanitary canal limits the diversion

of water to 4,167 c. f. s. The Sanitary District cannot comply with the State laws and at the same time satisfy federal authorities under existing permits. The limitation to 4,167 c. f. s. fixed by the Secretary of War was in the interests of navigation on the Chicago River. It was felt by the War Department that a greater diversion would create objectionable currents in the Chicago River. Since the permit was issued the cross section of the Chicago River has been greatly increased and bridges and other obstructions removed so that with the present diversion of 8,500 c. f. s. objectionable currents in the Chicago River do not exist. Moreover, the Calumet Sag channel has now been completed so that 10,000 second feet of water may be diverted and the objections of the Secretary of War to adverse currents in the Chicago River do no longer exist.

In negotiating for the approval of plans of the Illinois Waterway with the Chief Engineers, U. S. Army, he required that we so design the channel that the necessary depth would be obtained with a diversion from Lake Michigan of not to exceed 4,167 c. f. s. The plans have been so drawn and with that diversion the minimum depth in earth will be 8 feet or more. With the present diversion from Lake Michigan, there will be a channel depth of 9 feet. When our plans were submitted to the Federal Water Power Commission, that body required the structures to be so located that the greatest possible use of the surplus waters for power purposes would be obtained. The structures were so located, therefore, that ample room would be given for power plants to develop 10,000 cubic feet per second plus the natural flow of the Illinois and DesPlaines rivers. In normal sequence of work on the Illinois Waterway, it will soon be time to actually design the channel and start excavation. Power plants should be designed and head gates constructed along with the construction of locks and dams. In leasing the surplus power, the State must know the amount of water and hence the amount of power that it will have to lease. Unless and until this is known, the State cannot lease its power to the best advantage.

The Illinois Waterway is the connecting link between the navigable waters of the Mississippi valley and the Great Lakes. When this project is completed, there will be through navigation to New Orleans for vessels that can navigate channels having a minimum depth of six feet at low water. The manufacturing and shipping interests of this State cannot secure the greatest benefit from its magnificent waterway until the channels of the Illinois and Mississippi rivers have been improved to a depth of nine feet or greater.

Certain interests along the banks of the Illinois River are objecting to the small diversion from Lake Michigan because of the smell from the sewage brought from the Chicago Sanitary District. This smell would be greatly lessened if the diversion were increased to comply with the State laws. On the other hand, owners of low-lying lands along the banks of the Illinois River are objecting to the large diversion from Lake Michigan because of inundating certain portions of their land. This inundation would be increased by an increased flow from Lake Michigan in compliance with State laws. Here are conflicting interests—one asking for an increased flow, the other for a decreased flow. Both could be satisfied, at least in a measure, by a further improvement of the Illinois River, increasing its channel depth to nine feet and removing all of the present locks and dams, which are an obstruction to navigation with the present flow from Lake Michigan. The small size of the existing locks, 75 feet by 350 feet, will necessitate the breaking up of fleets which will add materially to the cost of transportation and slow up the time of transit.

The waters of the Illinois and Mississippi rivers are under the control of Congress, and the War Department has from time to time made surveys of these streams to determine the cost of their improvement and to recommend depths to which they should be improved. A special Board of Engineers was appointed pursuant to Section 1 of the River and Harbor Act approved March 2, 1907 to report on proper depth to improve the Illinois and Mississippi Rivers. (See House Document No. 50, Sixty-first Congress, First Session.) The conclusions of this Board are:

"The Board believes that an 8-foot channel from Chicago to St. Louis, corresponding to the present 8-foot project from St. Louis to Cairo, is the least that would adequately meet the demands of commerce, and believes such a waterway would be desirable, provided its cost is reasonable.

"Present and prospective demands of commerce between Chicago and the Gulf will be adequately served by a through channel 9 feet in depth, which may be obtained without violent changes of existing methods of improvement."

This conclusion met the approval of the Chief of Engineers. Nothing has been done since that date looking to the improvement of these rivers in accordance with the Engineer's recommendation, pending action of the State of Illinois in the improvement of the reach from Lockport to Utica. The State has now undertaken its part of this work, and pursuant to resolution of the Committee on Rivers and Harbors, the Chief of Engineers has estimated the cost of obtaining an 8-foot channel and a 9-foot channel in the Illinois and Mississippi rivers from Utica to St. Louis under present conditions. Col. W. V. Judson, Corps of Engineers, U. S. A., makes the following estimate of cost of improving the Illinois River to a channel width of 200 feet with all locks and dams removed from Utica to Grafton (See Document No. 2, Sixty-seventh Congress, First Session, page 16):

Flow from Lake Michigan.	8-foot depth.	9-foot depth.
4,167 c. f. s.	$3,134,400	$4,821,100
7,500 c. f. s.	1,310,100	1,987,700
10,000 c. f. s.	675,000	1,372,700

It will be seen from this estimate that if the flow from Lake Michigan is increased from 4,167 c. f. s. to 10,000 c. f. s., the Government will be saved an expenditure of $3,448,400 in the improvement of the Illinois River between Utica and Grafton, or in other words a 9-foot channel with 10,000 c. f. s. diversion can be secured for about 45 per cent of the cost of securing an 8-foot channel with a diversion of 4,167 c. f. s. Col. Burgess in the same report points out the value of this additional flow in the improvement of the Mississippi River from Grafton to St. Louis, but does not go into detail to show the saving that would be realized by the additional flow. He does say that it would be of material benefit and that a wider navigable channel would result. Both these officers indicate that the additional flow would result in a saving in annual cost of maintenance. For our present purposes, it is estimated that the saving in cost of improving the Mississippi River and the capitalized saving in maintenance for the Illinois and Mississippi Rivers would amount to $1,000,000.

Every federal engineer who has studied this question recognizes the advantages or even necessity of improving the Illinois and Mississippi rivers so as to give greater depth and better channels for navigation. The experiences of the Mississippi Warrior Barge Service, now operating on the lower Mississippi, shows clearly the necessity of a depth of at least nine feet for economical transportation between Chicago and the gulf. Col. W. V. Judson found in House Document No. 2, Sixty-seventh Congress, First Session, that with the diversion of 10,000 c. f. s. from Lake Michigan the Illinois River could be improved to a depth of nine feet at a cost of $1,372,700, and this could be done with the removal of all of the existing locks and dams, thus affording open river navigation and lowering the pool elevations to the benefit of farm interests. If this additional flow from Lake Michigan is authorized, the government will be saved an expenditure of nearly five million dollars in the improvement of the Illinois and Mississippi rivers. The State will be saved a large amount of money in the completion of its Illinois Waterway project and the additional value of power that may be obtained from water now going to waste will amount to many millions of dollars more. The total value of this additional water to the Middle West in navigation, farm interests, sanitary needs, and power, will exceed thirty million dollars.

The East, notably New York, claims proprietary right in water diverted from Lake Michigan. While it may have a shadow of title to these waters,

it cannot urge damage until the surplus waters are actually used. The spirit of the time seems to be conservation of our natural resources. We have here an example of water from the Great Lakes flowing to the sea unused whereas there is an immediate demand and market for this water in the Mississippi Valley where the value of its use probably exceeds any value that can be shown to a like amount of water passing eastward to the Atlantic. Surely no State should prevent a sister state from enjoying the benefit of this water so long as it is not being directly or indirectly damaged. The use of this water is vital to transportation interests and to the very life of the industries of the middle west. The Federal Government has recently completed the construction of the Panama Canal for which the State of Illinois pays its share of taxes. The benefits of this canal accrue largely to Atlantic and Pacific coast regions to the detriment of interior points. The Middle West desires to avail itself of the use of the Panama Canal in the markets along the west coast of the Americas and the Orient. It can only do so by the completion of an adequate waterway from Chicago to the Gulf. Such a waterway would partially overcome the handicap that New York now enjoys by the completion of the Panama Canal.

The diversion of water from Lake Michigan raises an international question inasmuch as the waters of the lake naturally flow through Canadian territory. Navigation interests along the Great Lakes also object to this diversion on the ground that it will lower the water of Lake Michigan, Lake Huron and Lake Erie. These questions were considered in great detail by the International Commission in "Boundary Waters Treaty," which treaty was signed at Washington January 11, 1909 and ratifications were exchanged May 5, 1910.

In considering the question of diversion at Chicago, the Dominion's view was expressed by the Canadian section of the International Commission dated April 25, 1906 is shown in the following words:

"At Chicago, the Americans have built a drainage canal which, when in full operation, will use about 10,000 cubic feet of water per second.

"As the diversion from Lake Michigan to the Mississippi River is of a much more serious character than the temporary diversions from the Niagara River, it is felt that the amount of water to be taken on the American side of the Niagara River should be limited to 18,500 cubic feet per second.

"If our proposal is carried out the diversions will be about as follows:

DIVERSIONS ON THE AMERICAN SIDE.

	Cubic feet per second.
Niagara Falls	18,500
Chicago drainage canal	10,000
Total	28,500

DIVERSIONS ON THE CANADIAN SIDE.

	Cubic feet per second.
Niagara Falls and on the Niagara peninsula	36,000

"Permanent or complete diversions of such waters are wrong in principle and should hereafter be absolutely prohibited. The diversions by the Chicago drainage canal should be limited to the use of not more than 10,000 cubic feet per second.

"This would give an apparent advantage to Canadian interests, but, as the diversion is not of serious injury to the falls and does not materially affect the interests of navigation, it is more than counter-balanced by the complete diversion of 10,000 cubic feet by way of the Chicago drainage canal to the Mississippi River."

As the treaty was finally drawn, the United States was allotted 20,000 cubic feet per second at Niagara Falls and the Dominion Government 36,000 cubic feet per second.

The International Waterways Commission made a report dated January 4, 1907 relating specifically to the Chicago Drainage Canal in the body of which report is said:

"The diversion of large bodies of water from Lake Michigan for supplying the drainage canal has not been authorized by Congress, but there appears to be a tacit general agreement that no objection will be made to the diversion of 10,000 cubic feet per second, as originally planned.

"The diversion of 10,000 cubic feet of water per second at Chicago will render practicable a waterway to the Mississippi River, 14 feet deep. Any greater depth must be obtained by the abstraction of more water from Lake Michigan and at the expense of the navigation interests of the Great Lakes and of the St. Lawrence valley.

"The effect upon Niagara Falls of diverting water at Chicago is of secondary importance when considering the health of a great city and the navigation interests of the Great Lakes and of the St. Lawrence valley, but it is proper to note that the volume of the falls will be diminished by the full amount diverted at Chicago.

RECOMMENDATIONS.

"The waters of Lake Michigan in the United States, the waters of Georgian Bay in Canada, and the waters of Lake Superior partly in the United States and partly in Canada, all form sources of supply of the Great Lakes system, finding their way by the St. Lawrence to the sea. All are interdependent and there can be no diversion from any of them without injury to the whole system. By Article XXVI of the treaty of 1871 it is provided that 'navigation of the river St. Lawrence, ascending and descending from the forty-fifty parallel of north latitude, where it ceases to form the boundary between the two countries, from, to and into the sea, shall forever remain free and open for the purposes of commerce to the citizens of the United States, subject to any laws and regulations of Great Britain or of the Dominion of Canada, not inconsistent with such privileges of free navigation.' It is desirable that in any treaty arrangement the waters of Lake Michigan, Georgian Bay, and all other waters forming part of the Great Lakes system should be declared to be 'forever free and open for the purposes of commerce' to the citizens of the United States and the subjects of His Britannic Majesty; subject to any laws and regulations of either country not inconsistent with such privilege of free navigation.

"The preservation of the levels of the Great Lakes is imperative. The interest of navigation in these waters is paramount, subject only to the right of use for domestic purposes, in which term is included necessary sanitary purposes. In our report of November 15, 1906, upon the application of the Minnesota Canal and Power Company to divert certain waters in Minnesota we recommend, among other things—'that any treaty which may be entered into should define the uses to which international waters may be put by either country without the necessity of adjustment in each instance, and would respectfully suggest that such uses should be declared to be (a) uses for necessary domestic and sanitary purposes; (b) service of locks for navigation purposes; (c) the right to navigate.' It is our opinion that so far as international action is concerned a treaty provision of that kind is all that is required in this case. We accordingly renew our recommendation of November 15, 1906, just quoted.

"A careful consideration of all the circumstances leads us to the conclusion that the diversion of 10,000 cubic feet per second through the Chicago River will, with proper treatment of the sewage from areas now sparsely occupied, provide for all the population which will ever be tributary to that river, and that the amount named will therefore suffice for the sanitary purposes of the city for all time. Incidentally it will provide for the largest navigable waterway from Lake Michigan to the Mississippi River, which has been considered by Congress.

"We therefore recommend that the Government of the United States prohibit the diversion of more than 10,000 cubic feet per second for the Chicago Drainage Canal."

It, therefore, appears that the International Commission charged the United States with the diversion of 10,000 cubic feet of water at Chicago in parceling the amount that should be diverted at Niagara Falls. The living members of this Commission remember the question distinctly and will certify to the correctness of this quotation. The diversion of water at Niagara Falls has continued as per the treaty and the United States has been charged with the 10,000 cubic feet diversion at Chicago, although it has not yet diverted that amount. It would seem, therefore, that in justice the Canadians should not object to the full 10,000 cubic feet diversion at Chicago.

The navigation interest is a more serious question and not only this diversion, but the diversion at Niagara Falls is damaging navigation by the reduced elevation of water in the lakes.

The value of additional water to the interests of the middle west for navigation, sanitation and power purposes is great. Such value was pointed out by the writer to the Chief of Engineers, U. S. Army, in a letter addressed to him under date of February 14, 1922. A portion of that letter is printed below:

"The State of Illinois has begun the construction of a waterway for interstate commerce connecting the Great Lakes with the Mississippi River System of navigable waters. This waterway will give an outlet to the sea for all the states bordering on the Great Lakes. Permit for the construction of this waterway was obtained from the Secretary of War under date of March 4, 1920. The completion of this waterway requires the construction of four dams and five locks. Before the work of construction on these structures had begun, the Federal Water Power Law was enacted, and it became necessary for the State authorities to apply to the Federal Water Power Commission for approval of plans for the dams and water power structures incident to the improvement. Preliminary plans were approved by that commission under date of January 14, 1922.

"In designing the waterway, it was found necessary to so locate and design the dams that the greatest possible use of the surplus waters for power purposes would be obtained. This requirement is insisted upon by the Federal Water Power Commission. The State will have as an adjunct or a by-product to its waterway a certain amount of power that may be developed from the natural flow of the stream plus a portion of that diverted from Lake Michigan. In designing these power plants it has been estimated that 4,167 c. f. s. from Lake Michigan would be available, and the State might reasonably contract the sale of energy from such an amount of water. If the flow from Lake Michigan can be increased to 10,000 c. f. s., the State will have available for sale 200,000,000 k. w. hrs. additional annually.

"This power is easily worth 4½ mills per k. w. hr. and this represents an annual income of $900,000. The annual interest, operation and maintenance charges on power plants necessary to develop this additional power is estimated to be $250,000, leaving a net income to the State of $650,000, which capitalized at 5 per cent amounts to $13,000,000, and represents the value to the State of the additional water for power purposes.

"The Illinois River from Utica to the mouth is under the control of and is improved by the Federal Government with the exception of the two locks at Henry and Copperas Creek. The present Federal project on this reach of the river calls for a channel depth of 7 feet not yet completed. The locks on this reach of the river have a width of 75 feet and length of 350 feet, whereas the locks which the State of Illinois is building under the Illinois Waterway Act are 110 feet wide and 600 feet long. Benefits of the Illinois Waterway will not be realized until the lower river is improved and the existing locks removed.

The Illinois Waterway Act of 1919 provides that channel depth for the Illinois Waterway shall be at least 8 feet. Plans of the river sections now nearing completion provide for a depth of 8 feet at extreme low water with 4,167 c. f. s. flow from Lake Michigan. The locks are designed to have a depth of 14 feet over the miter sills at low water stage. With an increase in flow from Lake Michigan to 10,000 c. f. s., the channel depth will be easily 9 feet at the shoal places, increasing to as much as 30 feet in some of the pools. To obtain the desired outlet to the gulf, the Illinois and Mississippi rivers should be deepened to correspond with the improvements to be made by the State of Illinois. A special Board of Engineers was appointed pursuant to Section 1 of the River and Harbor Act approved March 2, 1907 to report on proper depth to improve the Illinois and Mississippi rivers. (See House Document No. 50, Sixty-first Congress, First Session). The conclusions of this board are:

'The Board believes that an 8-foot channel from Chicago to St. Louis, corresponding to the present 8-foot project from St. Louis to Cairo, is the least that would adequately meet the demands of commerce, and believes such a waterway would be desirable, provided its cost is reasonable.

'Present and prospective demands of commerce between Chicago and the Gulf will be adequately served by a through channel 9 feet in depth, which may be obtained without violent changes of existing methods of improvement.'

This conclusion met the approval of the Chief of Engineers. Nothing has been done since that date looking to the improvement of these rivers in accordance with the Engineers' recommendation, pending action of the State of Illinois in the improvement of the reach from Lockport to Utica. The State has now undertaken its part of this work, and pursuant to resolution of the Committee on Rivers and Harbors, the Chief of Engineers has estimated the cost of obtaining an 8-foot channel and a 9-foot channel in the Illinois and Mississippi rivers from Utica to St. Louis under present conditions. Col. W. V. Judson, Corps of Engineers, U. S. A., makes the following estimate of cost of improving the Illinois River to a channel width of 200 feet with all locks and dams removed from Utica to Grafton (See Document No. 2, Sixty-seventh Congress, First Session, page 16):

Flow from Lake Michigan.	8-foot depth.	9-foot depth.
4,167 c. f. s.	$3,134,400	$4,821,100
7,500 c. f. s.	1,310,100	1,987,700
10,000 c. f. s.	675,000	1,372,700

In addition to the value of this additional water to the State and Federal Governments, it has a value to corporate interests now developing water power at Lockport and Marseilles. The increase in flow to 10,000 c. f. s. would add 140,000,000 k. w. hrs. to the power available at these two sites. This power is of equal value to that to be developed by the State, and if our reasoning is sound, this additional energy is worth $9,100,000.

The present Illinois State Law requires that the Sanitary District of Chicago shall discharge into the Illinois River 333⅓ cubic feet per second for every 100,000 population of the Sanitary District. The Sanitary District now includes a population of approximately 3,000,000 people, and would therefore require a discharge into the Illinois River from Lake Michigan of 10,000 cubic feet per second to comply with the State law. Foreign countries, notably in Europe and British Isles, require a much greater dilution of sewage when discharged into their streams. Experience on the Illinois River since this law was enacted and the Sanitary Canal opened in 1900 has shown that the dilution is not sufficient to protect the life of fish or to protect the interests of navigation. Boat owners navigating the stream are bitter in their denunciation of conditions that prevail along the river at this time, and have repeatedly appealed to the office of the Division of Waterways, State of Illinois, to remedy existing conditions.

The value of the additional water with a flow of 10,000 c. f. s. to the State of Illinois, to the Federal Government, and to corporate interests as above outlined is:

1.	Decreased cost of completing the Illinois Waterway.....	$ 2,000,000
2.	The value of additional water power appurtenant to the Illinois Waterway	13,000,000
3.	Decreased cost to the Federal Government in securing 9-foot channel on the Illinois River.....	3,448,400
4.	Decreased cost to the Federal Government and capitalized saving in maintenance of the Illinois and Mississippi rivers	1,000,000
5.	Value of additional water power at Lockport and Marseilles	9,100,000
	Total.....	$28,548,400

It is very essential that a depth of 9 feet on the Illinois and Mississippi rivers between Chicago and New Orleans be obtained. The value of an additional three feet under the keel of a vessel is brought out very clearly in the report of the Tow Boat Board. (See House Document No. 857, Sixty-third Congress, Second Session and also see Reports of the Federal Mississippi Warrior River Service.) The operation of this barge line shows that when the depth is decreased from nine to seven feet, the cost of haul greatly increases. A tabulation is appended hereto showing the cost of transportation per ton mile based on the experiments of the Tow Boat

TABULATION OF COST OF FREIGHT TRANSPORTATION.

In 6 barges (2 abreast and 3 long) at various speeds and with towboats of varying indicated horse powers (I. H. P.).

Investments—Barges at $15.00 per ton of capacity, and towboats at $100 per I. H. P.

Coal Consumption—2¼ lbs. per I. H. P. hour; towing hours, 3,600 per year.

Towrope H. P. equals 30 per cent of I. H. P.

Computed from data in Towboat Board Report H. D. 857—Sixty-third Congress, Second Session.

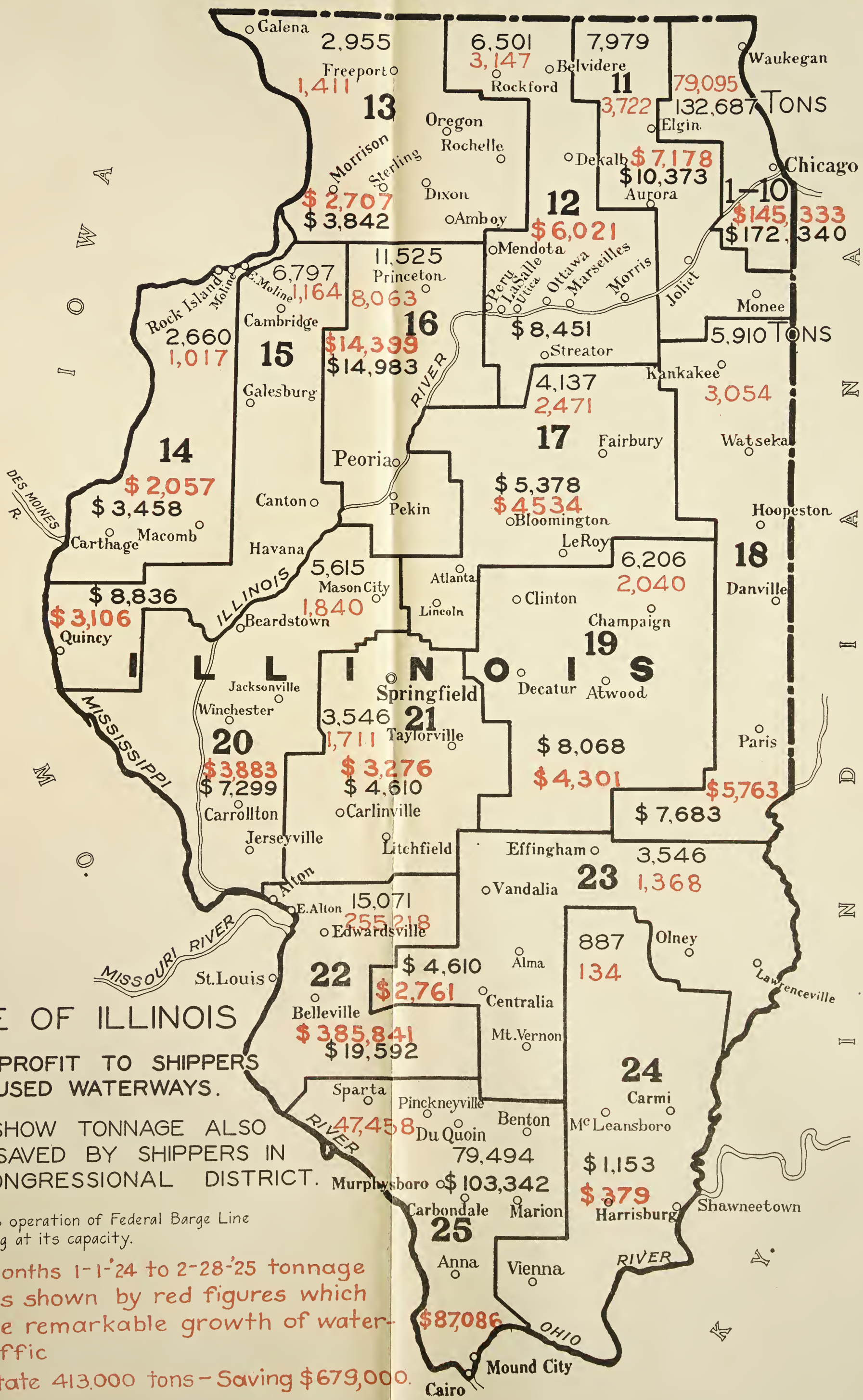
Tons of displacement.		Speed—miles per hour.	Tow rope H. P.	Boat of I. H. P.	Per ton mile of cargo capacity.				
Total.	Cargo.				Pounds of coal.	(1) Coal.	(2) Wages.	(3) Fixed charges.	Total cost.
						Mills.	Mills.	Mills.	Mills.
5,600	4,500	7	845	2,817	.205	.307	.221	.554	1.082
5,600	4,500	6	475	1,583	.133	.200	.256	.417	.873
5,600	4,500	5	246	820	.086	.129	.308	.332	.769
5,600	4,500	4	128.5	428	.054	.080	.385	.306	.771
11,200	9,000	5	492	1,640	.086	.129	.154	.332	.615
2,200	----------	6.9	492	1,640	.059	.089	.112	.240	.441
									1.056
11,200	9,000	4	257	856	.054	.080	.192	.307	.578
2,200	----------	5.8	257	856	.037	.056	.132	.211	.399
									.977

Above with 9 foot depth of water.
Below with 7 foot depth of water.

8,500	7,000	4	210	700	.0563	.085	.248	.312	.645
1,550	----------	5.85	210	700	.0385	.058	.170	.214	.442
									1,087

(1) Cost of coal at $3.00 per ton.
(2) Wages and subsistance at $2,500.00 per year.
(3) Fixed charges, 18% on investment in boats and barges.

WATERWAYS REDUCE FREIGHT RATES



STATE OF ILLINOIS

SHOWING PROFIT TO SHIPPERS WHO USED WATERWAYS.

FIGURES SHOW TONNAGE ALSO AMOUNT SAVED BY SHIPPERS IN EACH CONGRESSIONAL DISTRICT.

Thirty months operation of Federal Barge Line working at its capacity.

Fourteen months 1-1-'24 to 2-28-'25 tonnage and savings shown by red figures which indicate the remarkable growth of water-borne traffic

Total for State 413,000 tons – Saving $679,000.

Completion of Illinois Waterway Should Increase These Shipments and Savings Ten Times

Board above referred to. The cost is computed for channel depths of seven feet and nine feet and with speed of four miles per hour loaded and 5.8 miles per hour returning boats empty. These computations are based on dead water navigation. Probably 50 per cent of the distance from Chicago to the mouth of the Illinois River is practically dead water. The error in these computations when applied to practical navigation is that a greater power of tow boat is required. If these computations are corrected to comply with the experience of the Mississippi-Warrior River service, it would add about 10 cents per ton to the cost of haul as indicated by the tabulation. However, the chart is relative only and shows that for a haul of 400 miles an additional depth of two feet lessens the cost of haul 4.4 cents per ton. This is less than the showing by experience in practical navigation and undobutedly the difference exceeds 6 cents per ton, which figure will be used in these comments.

Commerce now in sight for the Illinois River, based on present needs, probably exceeds 20,000,000 tons annually. Chicago used last year 36,000,000 tons of coal, and its demand has increased a million tons annually for the past two decades. Illinois coal used in the Chicago district last year exceeded 16,000,000 tons. Large producers and users of coal have estimated for the writer that if a navigable depth of nine feet is assured, one can easily count on 15,000,000 tons of coal annually for transportation on the Illinois River. The present rail rate on coal from the southern Illinois District to Chicago is $2.17 per ton. With the completion of an adequate 9-foot waterway from Chicago to St. Louis and below, it is estimated that at least $1.00 per ton saving can be realized in transporting this coal by water. The detailed cost of transportation via water is as follows:

Mine to river by rail 40 miles @ 8 mills	$0.32
Loading barges from tipple	.02
Tipple to Chicago by water 400 miles @ .6 mills	.24
Unloading at Chicago	.10
Chicago to tipple empty 400 miles @ .4 mills	.16
Insurance	.05
Margin for profit or contingencies, 18 per cent	.20
	$1.09
Present rail rate (1922)	2.17
	$1.08

Saving per ton, say $1.00.

Saving per annum, $15,000,000.

In these computations the transportation cost is based on the tabulation herewith which includes an item for interest and depreciation on the floating equipment amounting to 17½ per cent. In addition thereto the last item of the above table covers an additional margin of 18 per cent on the floating equipment, and in this computation it is estimated that the boats are traveling only 50 per cent of the time. To the coal tonnage must be added lumber and manufactured articles, such as:

Coffee	30,000 tons
Canned goods	20,000 tons
Sugar	210,000 tons
Sisal	125,000 tons
So. lumber	1,500,000 tons
Farm machinery and general merchandise	1,000,000 tons
Total	2,885,000 tons

To this commerce must be added the transporting of an almost inexhaustible supply of moulding sand lying immediately adjacent to the Illinois River in the vicinity of Ottawa. This sand is used in large quantities at all the foundries and steel mills along the rivers of the Mississippi Valley and on the Great Lakes. With the enormous commerce now in sight, it is reasonable to suppose that soon after the completion of improved

channels an annual traffic of 20,000,000 tons will seek transportation on these rivers. The saving of 9-foot channel over 7-foot channel based on above computations, amounts to $1,200,000 annually, which if capitalized at *6 per cent* shows the value of 9-foot channel over 7-foot channel to be $20,000,000.

It may be proper at this time to point out the importance of the Illinois River as a factor in transportation in the Middle West. Heretofore much stress has been laid on the importance of improving the upper Mississippi, meaning the reach from St. Louis to St. Paul. Without attempting to detract from the importance of improving that stream, the writer desires to call attention to the greater importance of improving the Illinois River and connecting the Mississippi system with the Great Lakes. Chicago may be said to be at the head of the Illinois River while St. Paul and Minneapolis are at the head of the navigable waters of the Mississippi River. To show the relative importance of these streams, the entire population of the states of Minnesota and North Dakota do not exceed the population of the Chicago district alone. The principal product of the fields of North Dakota and

Steamer Golden Eagle on Illinois River in 1925, 1400 barrels of apples in cargo.

Minnesota is wheat, the surplus of which finds its outlet to market most cheaply through Duluth, then via the Great Lakes to Buffalo and Montreal. No other grain surplus of the United States can compete with these states during the navigation season for a market in North Atlantic States. Moreover this commodity cannot reach seaboard via the gulf without competing with the surplus grain states of Nebraska, Missouri, Kansas and Oklahoma, having a much shorter haul both by rail and water. The products of the iron mines of Minnesota likewise find a market via the Great Lakes to Chicago, Cleveland, Buffalo and the Pittsburg district. No water transportation, however efficient, can attract much of this business southward, especially after the Tennessee River is improved giving an outlet for cheaper ore and cheaper iron and steel products from the Alabama district. On the other hand Chicago is probably the greatest consuming and producing center of freight in the United States. Its cheapest source of coal supply lies along the Illinois and Mississippi River requiring not to exceed 50-mile rail haul to deliver it to the navigable waters. Seventy-five per cent of the farm area of the products of the farm must reach the world markets

either via the gulf or the Atlantic. In either case, the cheapest means of transportation is by water. Chicago is rapidly becoming the center of the steel production in the United States. When favored with cheaper transportation for coal, ore, sand, limestone and other raw products and relieved from the iniquitous "Pittsburg plus" rule, its importance as a steel center will be greatly enhanced. Chicago is already established as the meat center of the United States and is also first in the production and distribution of farm machinery. As a consuming and distributing center for such articles as sugar, coffee, rice, lumber, sisal and other products of the south, it has no equal and the transportation of these commodities will require a larger fleet of boats than now exist on the Mississippi River.

The report of the Experimental Tow Boat Board gives much information relative to the value of additional depth and width of channel to the interests of navigation, Mr. L. D. Cornish, Assistant Chief Engineer, has compiled data from the Tow Boat Board report pertinent to Illinois Waterway conditions. His compilation is published below; and is followed by his analysis of transportation costs of the government operated barge line on the Mississippi River and their application to the Illinois Waterway.

EFFECT OF CHANNEL DEPTH AND AREA OF LOCK CHAMBERS ON COST OF HAUL BY WATERS.

Prepared by L. D. Cornish, *Assistant Chief Engineer,*
Division of Waterways, State of Illinois, for U. S. Senate Committee on S 4428—Sixty-seventh—Fourth.

October 11, 1923.

The report "Experimental Towboats H.D. 857—63—2 contains data from which the cost of haul by towboats and barges was computed by the writer in 1921 for a nine foot waterway. A subsequent report H.D. 108—67—1 gives the cost obtained in test runs of tow boats and barges of the government-operated Mississippi Warrior Barge line. These tests together with the annual reports of the Mississippi Warrior Barge line show actual operating costs which substantially agree with and check the writer's computed figures.

Based on these governmental reports the effect of channel depths and size of locks on the cost of haul will be shown. The costs shown are for hauling one ton a distance of 300 miles between Chicago and the mouth of the Illinois river. The costs include fuel, wages and subsistence of boat crews and 18 per cent on the cost of floating equipment to cover interest, depreciation and other fixed charges. Cargo capacities are based on the assumption of 3 feet of water under the barges, and through traffic in fleets of length and breadth to fill the lock chamber.

For 9 feet depths with locks 110 ft. x 600ft.

The maximum single fleet cargo is 9,000 to 10,000 tons.

Cost of haul is 30 to 45 cents per ton.

A diversion of 10,000 c.f.s. and appropriation by Congress of about $1,372,000 for construction and $75,550 annual maintenance will make this low hauling cost possible.

For 8 feet depths with locks 110 x 600 ft.

The maximum single fleet cargo is 7,500 to 8,000 tons.

Cost of haul 33 to 50 cents per ton.

This hauling cost would prevail with 4,167 c. f. s. diversion and the locks in the lower Illinois river removed and an eight foot channel provided by the Federal Government at an estimated cost of $3,134,000 and annual maintenance of $85,000.

For 9 feet depth with locks 75 x 350 ft.

The maximum single fleet cargo is 3,600 to 4,000 tons.

Cost of haul 37½ to 56 cents per ton.

This hauling cost would prevail with 4,167 c.f.s. diversion, the present locks retained, but the channel deepened to 9 feet by the Federal Government at a cost not yet estimated.

For 8 feet depth with locks 75 x 350 ft.

The maximum single fleet cargo is 3,000 tons.

Cost of haul 42 to 63 cents per ton.

This hauling cost would prevail with 4,167 c.f.s. diversion the present locks retained, but the channel deepened to 8 feet by the Federal Government, at an estimated cost of $1,465,800 and annual maintenance of $148,500.

For 7 feet depth with locks 75 x 350 ft.

The maximum single fleet cargo is 2,400 tons.

Cost of haul 46½ to 70 cents per ton.

This hauling cost would prevail with 4,167 c.f.s. diversion and nothing done by the Federal Government to further improve the Illinois river below Utica.

The cost estimates for improvement by the Federal Government stated above are taken from page 16 of H.D. 2—67—1.

The lesser cost of haul for each condition is for the most economical speed which is about 4 miles per hour. The range to the higher figure is to cover greater but less economical speeds so far as hauling cost alone is concerned.

The difference between the first and last hauling cost figures is from 16½ to 25 cents per ton and indicates the saving in cost of water transportation if 10,000 c.f.s. diversion is authorized and a 9 foot channel provided as against a restriction of diversion to 4,167 c.f.s. and nothing done to further improve the lower Illinois River.

A saving of 20 cents per ton in cost of haul between Chicago and the mouth of the Illinois River would amount to $2,000,000 per annum on an annual traffic of 10,000,000 tons which is only 17 per cent of the tonnage capacity of the locks being constructed by the State on The Illinois Waterway. If capitalized at 6 per cent, this saving indicates a valuation of $33,000,000.00 for the additional 5,833 c.f.s. of water diversion.

TRANSPORATION COSTS.

By L. D. Cornish, *Assistant Chief Engineer*

Revised from Fifth Annual Report.

The average freight rate on all the railroads in the United States was about 7½ mills per ton mile for a number of years and a special group of coal roads could be selected upon which the average was about 5 mills. The increases in freight rates during the past few years has about doubled these figures. For bulk commodities such as grain, coal,

sand and gravel on roads which are competitors of the Illinois Waterway and Mississippi River between Chicago, the Illinois Coal fields, St. Louis and New Orleans, the present rates average about 10 mills per ton mile.

Three facts relative to transportation are indisputable:

First—High freight rates are a tax on industry which restrict industrial and agricultural development.

Second—Every increase in freight rates reduces the area within which business can profitably be done.

Third—Water transportation is the cheapest of all.

The great question of interest, particularly to the people of Illinois, is what will the Illinois Waterway do toward providing cheaper transportation. An estimate might be made in considerable detail as to what the transportation cost should be but such estimates are inconclusive and invite attack as to their accuracy. The safest method of arriving at the probable rates on this waterway is to assume that the rate need be no greater than the actual rates on similar or inferior waterways in the United State at the present time. The reimproved navigable Monongahela River reaches 70 miles above Pittsburgh and is improved for 8 feet draft and has twin locks 56 ft. by 360 ft. Its single fleet lock capacity is about 3,000 tons or 30 per cent of the capacity of the Illinois Waterway locks. In recent years the traffic on this river has been as follows:

	Tons.	Value.	
1914	10,375,000	$20,714,000	
1915	11,815,000	28,980,000	
1916	12,876,000	35,673,000	
1917	16,009,000	64,210,000	
1918	16,538,000	64,720,000	80 per cent coal and coke
1919	14,630,000		Coal only
1920	20,718,000		Coal only
1921	15,000,000		Coal only—business depression
1922	14,407,681		
1923	23,560,024		
1924	21,878,815		

The coal traffic is a one way haul and the barges are returned empty. Government figures for cost of hauling this coal including 6 per cent interest and 10 per cent depreciation on equipment are as follows per ton mile; 2,000 ton fleet 5½ mills, 3,000 tons 3.12 mills, 4,000 tons 2.5 mills, 5,000 tons 2 mills, 6,000 tons 1.68 mills. The decrease in cost as the size of cargo increases show by the foregoing indicates that for 9,000 ton cargoes the cost would be about 1 mill per ton mile. These costs are for a waterway on which it is necessary to separate large fleets into 3,000 ton units at each lock. As the Illinois waterway locks can pass 9,000 ton fleets in a single lockage, it is apparent that the above indicated cost of 1 mill per ton mile should not be exceeded on such commodities as coal, ore, sand, gravel and grain.

Surely no one can dispute the claim that the cost of water transportation between Chicago and New Orleans or long hauls to intermediate points will not exceed the profitable rates now in effect between St. Louis and New Orleans. The government-operated Mississippi-Warrior Service between St. Louis and New Orleans has steadily im-

proved during the last five years and for the eleven months from May 31, 1924 to April 30, 1925, has shown operating profits before deductions for depreciation of $371,094.15.

This service is operated under a joint rail and water rate which is 80 per cent of the rail rate. These rates are effective over a large territory bordering the river and for the Northern Zone shipments are by rail to St. Louis or Cario thence by the barge line to New Orleans or intermediate points. The shipper saves 20 per cent of the through rail rate, but his saving is entirely at the expense of the barge line. The railroad gets about 31 per cent of the full through rail rates for its 280 mile haul to St. Louis and the barge line gets what is left. The result of this is that the barge line carries a great deal of freight from St. Louis to New Orleans at figures which are materially less than 80 per cent of the rail rate between those points.

The Barge line operating costs per ton for the fiscal year ending June 30, 1921, were as follows: Terminals $1.73, hauling $1.69, damages $0.18, and traffic and general expenses $0.52, total $4.12.* Of these, haulage varies almost directly with the mileage and it is reported that for full cargoes this item is less than 1½ mills per ton mile. The average terminal costs and damage claims are very high on account of the crude way of handling freight at some of the terminals. Results obtained at their completed modern terminals give assurance that the terminal costs will be reduced to $1.00 per ton and damage claims to below the railroad average of 2½ of freight receipts which for the barge line would be about 10 cents per ton. This statement is justified by the experience of the St. Louis-Kansas City Barge line whose damage claims were seventy-five per cent less per $1.00 of freight charges than those of the competing Missouri Pacific Ry. Co. The traffic and general expenses during the last three months have been reduced to 31 cents. These items plus $1.69 for haulage aggregate $3.10 as a liberal estimate of the operating cost per ton for barge transportation costs between St. Louis and New Orleans. The only material operating cost which should be added for through traffic between New Orleans and Chicago is the haulage cost for the additional 400 miles, which at 1½ mills per ton mile amounts to 60 cents per ton and the operating cost between New Orleans and Chicago may therefore be assumed as not exceeding $3.70.

The possibilities of profit to transportation companies and lower rates to shippers is indicated by the last column in the following tables which show the difference between $3.70 and the present Mississippi Warrior Service joint rail and water rates per ton. This difference is wide enough to justify the claim that rates on this waterway can be made as low as 50 per cent of present rail rates. Future reductions in the cost of labor and materials which may result in and justify lower rail rates will also justify lower water rates. The cost of carrying commodities varies greatly with their character, therefore the figures in the last column indicating the margin over actual cost may be badly in error for any particular item but the mean figures are essentially correct.

* The operating cost for June, 1923 was $3.003 per ton and averaged $3.29 for the entire year 1922. That these costs have not been consistently maintained is due to the fact that every year to date the barge line operations have had to be suspended or curtailed because of insufficient depth of water. The barge line report for 1923 shows as follows:

OPERATING COST PER TON OF FREIGHT HANDLED.

	1921	1922	1923	June, 1923
Terminals	$1 73	$1 45	$1 73	$1,186
Hauling	1 69	1 40	1 74	1,540
Damages	18	12	08	040
Traffic and general expenses	52	32	39	237
Total, excluding depreciation	$4 12	$3 29	$3 94	$3,003

FREIGHT RATES PER TON, C. L. L.

CHICAGO TO NEW ORLEANS.

	Rail rates.		Mississippi Warrior.	Mississippi Warrior less cost of $3.70.
	1913	1925	1925	
Agricultural implements	$7 20	$14 60	$12 00	$ 8 30
Canned goods	7 00	13 60	11 20	7 50
Dried fruit	8 20	13 00	10 70	7 00
Glucose	5 00	8 30	7 10	3 40
Packing house products	7 80	13 00	10 70	7 00
Paints—red and white lead	5 60	10 30	8 50	4 80
Rails	7 60	6 60	6 00	2 30
Salt	4 60	6.30	6 10	2 40
Soap	6 20	9 60	8 00	4 30
Starch	7 00	11 20	9 30	5 60
Steel—structural	5 60	11 40	9 40	5 70
Stoves and ranges	8 80	15 50	12 80	9 10
Varnishes	8 20	25 40	21 00	17 30
Mean	$7 44	$12 22	$10 22	$6 52
Wheat and corn for export	4 00	5 60	3 78	08

NEW ORLEANS TO CHICAGO.

Canned goods	$ 6 40	$13 60	$11 20	$ 7 50
Coffee	5 00	10 80	8 80	5 10
Cotton	10 34	21 90	18 90	15 20
Dried fruit	7 80	20 60	17 00	13 30
Glucose	5 80	8 60	7 10	3 40
Lumber	5 10	7 60	6 40	2 70
Petroleum	4 60	7 20	6 40	2 70
Rice	7 00	10 60	8 70	5 00
Sisal (import)	5 60	7 80	6 40	2 70
Sugar	4 86	10 80	8 80	5 10
Steel straight from Birmingham, Ala	6 00	10 60	9 20	5 50
Mean	$6 23	$10 92	$9 90	$6 20

THREE REASONS WHY SEA CARRIAGE IS CHEAPER.

(Figures by H. C. Gardner, President Great Lakes-St. Lawrence Tidewater Association.)

Sea carriage costs less than land carriage.

For long distance the rate by sea is not more than one-tenth as much per ton-mile as the corresponding rate by rail.

Here are three reasons:

I.

More money is invested in the railway than in the vessel. The invested capital per ton-mile of freight carried yearly on eight typical roads is as follows:

Illinois Central	$0.02108
Missouri Pacific	0.0638
Louisville & Nashville	0.033
Chicago, Milwaukee & St. Paul	0.0634
Erie	0.0434
Nickel Plate	0.0228
N. Y. Central	0.0443
Michigan Central	0.0340

Compare that with the invested capital per ton-mile in typical vessel lines:

Intercostal Line of ships	$0.00191
Fleet of bulk freighters on lakes	0.00285
Great Lakes Transit Corporation	0.00747
*GOV'T. BARGE LINE MISS. R.	0.0060

II.

The vessel burns less coal than a locomotive.

The coal used per ton-mile in 14 typical freight vessels, average 7,405 D. W. T., operated over a period of 930 days, per ton-mile of actual freight carried was 0.060145 lbs.

*TOW BOAT TESTS, 0.07.

The coal used by all class 1 railroads in the United States in year 1921 was 0.406 lbs.

III.

The operating costs of the vessel are less than the railroad. The cost of conducting transportation (wages, fuel, supplies) per ton-mile by rail is given as follows:

Nickel Plate	$0.00403
New York Central	0.00472

The cost of conducting transportation by vessels is given as follows:

Intercostal Line of Ships	$0.00119
Fleet of Lake Freighters	0.00039
*BARGE LINE (YEAR)	0.00098
*BARGE LINE (JULY)	0.00076

All engineering arguments clearly demonstrate the increased value of a nine foot channel over a six foot channel for navigation purposes between Chicago and New Orleans. These scientific deductions are clearly borne out in practice by the experience of the Federal Government in operating the Mississippi River Warrior Barge Service on the Mississippi River. At stages in the river when a 9-foot channel is surely available to Cairo, the barge service operates with profit but if the channel is not maintained and the stage of water is unusually low the profits quickly disappear. It is essential, therefore, that in order to reach the greatest usefulness of the Illinois waterway and the Mississippi River below Cairo, the Illinois River from Utica to Grafton and Mississippi River from Grafton to Cairo should be improved to a channel depth of nine feet at mean low water. With the same horizontal dimensions of a boat or a fleet of boats the cargo of a boat loaded to 5-foot draft is only from 50 to 60 per cent of the cargo capacity of a boat loaded to 8-foot draft. Difference in cost of barges and tow boat for

* By L. D. Cornish from 1923 report of Chief of Inland and Coastwise Waterway Service.

these different drafts is very small. The labor and maintenance cost for crew is identical. The difference in cost of fuel for transportation is small. Hence it is easy to see why barge traffic may not be successful on a 6-foot draft, whereas it will show a handsome profit on a 9-foot draft.

No time should be lost in securing proper legislation from Congress now that the Illinois Waterway is nearing completion.

With the completion of the Illinois Waterway and the improvement of the lower Illinois River a large amount of freight surely will be brought to the Chicago harbors by water. At present the facilities in Chicago are inadequate for the accomodation of much barge traffic. The Federal, State and City authorities should cooperate in developing a scheme of harbor improvement that will accomodate a large traffic by barge through the Mississippi valley and provide for a proper meeting with rail and ship transportation at Chicago and forwarding to other points, as well as for its accommodation for Chicago's need.

The Federal Barge line now operated between New Orleans and Cario and St. Louis is taxed to its capacity and those in charge of this fleet reported that traffic over it is many times its carrying capacity. At present this fleet is forwarding for northern Illinois points at least 100,000 tons per year at a saving to the consumer of approximately $200,000 annually. A state map printed elsewhere in this document shows how this water-borne traffic is spread over the State by congressional districts. This traffic can only reach the upper part of the State through a long rail haul. Surely if these barges can sail directly to Chicago, the amount of traffic such fleets will haul will increase many fold. In 1923 the Illinois State Chamber of Commerce completed a canvass of the cities represented by the Chamber and estimated the tonnage these cities would have for transportation by water when the Illinois Waterway is completed. This canvass, although incomplete, shows a prospective traffic of close to 25,000,000 tons. A compilation of this canvass follows:

POTENTIAL WATERWAY TONNAGE.

The Illinois State Chamber of Commerce has just completed a canvass of the cities represented by the Chamber asking for an estimate of the tonnage these cities would have for transportation by water when the Illinois Waterway is completed.

As is usual in such cases, shippers did not respond as well as they should. However, the replies received indicate a very material tonnage awaiting transportation by water. The following list shows the estimated receipts and shipments and the number of firms reporting:

City.	Number of firms reporting.	Tonnage.	
		Receipts.	Shipments.
Alton	5	9,000	15 000
Aurora	7	4,000	12,000
Annawan	1	1,600	25,000
Beardstown	8	5,000	400
Belleville	1	400	300
Bloomington	6	3,200	500
Blue Island	1		9,000
Chicago	42	302,000	152,000
Chicago	Grain estimate	1,000,000	
Chicago	Sand and gravel estimate	3,000,000	
Chicago	Coal estimate	15,000,000	
Chicago Heights	5	2,700	4,400
Cicero	5	6,700	7,200
Federal	1		52,000
Joliet	23	420,000	954,200
LaSalle	4	300,000	1,001,000
Litchfield	1	500	500
Moline	3	12,500	5,000
Morris	9	122,400	52,300
Murphysboro	5		84,000
Ottawa	5	40,200	622,400
Peoria	1	148,000	
Pekin	4	73,000	88,000
Quincy	4	7,600	12,200
Rock Island	3	2,400	2,000
Waukegan	2	91,000	40,000
		20,552,200	3,139,400

This indicates a traffic of nearly 25 million tons. This is an excellent showing and inciates a potential tonnage now available in excess of the maximum capacity of the New York canals recently constructed. Much of this business is made up of small shipments which will require public terminals for receipts and shipment. It is believed that the tonnage reported does not represent all that is actually available and that when the waterway is completed and properly equipped with public terminals, the amount of freight shipped will soon be in excess of the amount shown on this list.

This belief is substantiated by comparing the data for Peoria in above table, viz., one firm reporting receipts of 148,000 tons, with the testimony given before and published on p. 271 of Vol. 1 of the Senate Committee on the 9-foot channel from Great Lakes to Gulf. The following is tabulated from the testimony referred to which was given by J. B. McCoffery, Manager of the LaSalle and Bureau County Railroad. Annual Tonnage of LaSalle, Illinois, Switching District.

Commodity.	Out Bound.	In Bound.
Coal	500,000	900,000
Cement	1,100,000	.....
Zinc ore	.....	300,000
Sulphuric acid	140,000	.....
Spelter	50,000	.....
Sheet Zinc	40,000	.....
Zinc Oxide	40,000	.....
Clay	90,000	10,000
Gypsum	.....	37,000
Miscellaneous	40,000	40,000
	2,000,000	1,287,000

With a 9-foot channel and a dependable barge line service schedule probably more than half this tonnage would be diverted to the cheaper water haul.

The Chicago Association of Commerce estimates the tonnage available for transportation over the Ilinois Waterway from its city to be upwards of 1,000,000 tons, exclusive of coal, grain and ore. Inasmuch as the present tonnage by Federal barge line to the Chicago shipping district is now approximately 100,000 tons, although forwarded by rail the entire length of the city, it is reasonable to assume that if this freight could reach Chicago without rail haul that a million tons would be forwarded by water exclusive of the heavy bulk commodities.

The General Assembly of 1921 passed an Act by which the City of Chicago may improve Lake Calumet as an industrial harbor. Although the city has been negotiating with various interests, and notably the Nickel Plate Railroad, in an effort to start some development at Lake Calumet, nothing has yet crystalized in anything that promises an important development. The proper development and utilization of Lake Calumet and other waters in this vicinity is one that cannot be decided in a moment and should receive careful, thoughtful study of experts in terminal development. So far as this office is informed, no such studies have been made.

GENERAL WATERWAY IMPROVEMENT.

By an Act of the General Assembly of 1923 the State acquired title to a lock and dam that a few years before had been built in the Fox River by private funds about two miles below McHenry. At this dam there is a head of about forty inches, and the pool created by it extends up stream through the various lakes at the head waters of the Fox River near the Illinois-Wisconsin State line. The purpose of this dam was to afford better fishing and boating facilities for pleasure purposes. Before the dam was constructed water front property along the River and the Lakes above the dam could be purchased at from $50 to $100 per lot of sixty-six feet each. The creation of this pool has greatly enhanced the value of this property, so that today water front lots are selling at from $2,000 to $10,000 each. The advent of the automobile, and the construction of the State's magnificent system of hard roads has attracted attention to any water front that may be improved for residential sites, or for fishing, boating, parks and other playground. The construction of this lock and dam at McHenry, costing less than $20,000, has added hundreds of thousands of dollars to the taxable property of McHenry and Lake Counties, and the damage to private or public property has been nil. In addition to increasing the value of taxable property it has created a very attractive playground and summer resort for the residents of Chicago less than a two hour automobile drive distant.

The city of Decatur on the Sangamon River recently constructed a dam for water supply purposes which created a large lake above the City known as Lake Decatur. While serving its purpose as a water supply for the City, there is an incidental income from renting the shores for boating and residential sites that is very material. Here also is found a playground and park for the residents of Decatur and other nearby points. Similarly in many parts of the State the people are taking advantage of their waterways by improving them for pleasure

purposes. In the past we have looked upon our waterways largely as a means of transportation. Under modern conditions we find that these waters have another use that should be utilized and improved.

In creating the Rivers and Lakes Commission the Legislature foresaw this use of our waters, and said:

"It shall be the duty of the Rivers and Lakes Commission to plan and devise methods, ways and means for the preservation and beautifying of the public bodies of waters of the State of Illinois, and for making the same more available for the use of the public."

It also imposed on the Rivers and Lakes Commission the duty of protecting and beautifying such bodies of water, and giving advice and aid to those contemplating such improvement. The State Division of Waterways is frequently called upon for such aid, and is always willing through its engineering organization to do what it can to aid the people in improving our natural waterways for pleasure purposes. Such improvement should be fostered and aided in every way.

In the past many of our streams were used for transportation purposes at a time when there was no transportation by rail, and highways were such as nature afforded. Navigation on the Rock River was of considerable importance in the first half of the Nineteenth Century, and if properly improved and protected would yet afford some service for transportation as well as lending itself to improvement for pleasure purposes. Some instances of the early navigation of the Rock River are told by Mr. H. C. Alexander, an Engineer of this division, whose notes are appended hereto.

September 17, 1925.

"From H. C. Alexander, Engineer
To M. G. Barnes, Chief Engineer.
Subject:

During the fiscal year from July 1, 1924 to June 30, 1925 the Division of Waterways issued permits as follows:

Temporary piers	24
Permanent piers	12
Dredging	14
Docks	56
Sewerage Systems or Disposal plants	25
Bridges	28
Dams	7
Shore walls on limit lines	10
Tunnels	2
Electrical Aerial cables	6
Electrical Submarine cables	7
Bulkheads	5
Submerged pipe lines	5
Drainage Districts	3
Harbors	2
Shore Limits Surveys	10
Total	216

INVESTIGATIONS other than for Permits:

Pollution	24
Encroachments	10
Division of Highways Bridges	15
Miscellaneous	21
Total	70

These permits require investigations in the field and office and reports prepared before deciding whether they should be granted.

The pollution of the streams and lakes in the State often requires extended investigation to determine the source of such pollution and also what may be the proper method to be pursued to eliminate the evil of its source.

SPECIAL INVESTIGATIONS.

Pollution of public waters of the State sewage and plant wastes continues and 24 complaints have been investigated and reported upon.

Carelessness in handling gasoline and machine oils has become a source of pollution that is difficult to suppress and without the cooperation of the public the streams and lakes, contaminated as they are with sewage and plant wastes, will become so polluted that fish life will cease.

ENCROACHMENTS.

Obstructions to or encroachments on the streams and lakes have frequently occurred and it is assumed that when done by industrial plants they have done so because it was the line of least resistance in disposal of refuse including ashes. Never the less it has a tendency to restrict the capacity of a stream to discharge flood waters.

Owners of shore lands on lakes, sometimes try to control the use of public waters to their own financial gain where the public is largely interested. Sometimes an adjustment of interests is effected, while in other instances recourse to the courts is necessary.

The automobile has made the lands along streams and near the lakes accessible with the result that many now spend the week ends in the country where the air is free from dust and smoke and enables entire families to picnic, quitely together in the open spaces around the cities.

BRIDGES.

No structures may be built over or in any stream without approval of the Division of Waterways. This prevents encroachment on the flood plane and reduces the danger from floods with consequent damages. There are no fees for the granting of permits of whatever character and the only expense attendant upon securing a permit is the presenting of an application accompanied by maps and plans showing the character of the proposed structures and their relation to the stream conditions.

In our work we are guided by the law and not by office rules and anyone may easily secure information as to the procedure by reading carefully the statutes enacted for the guidance of all.

H. C. Alexander, Engineer."

ROCK RIVER NAVIGATION.

Rock River is one of the navigable rivers of the State and while existing dams and bridges limits the use of large boats to small areas in which to carry on commercial transportation, it may in the future become one of the most important links in the chain of the State system of water transportation when canalized.

Many years before the building of railroads in the Northern part of the State, the river was navigated by boats carrying passengers and with miscellaneous cargoes which were made necessary by the increased population along or within teaming distance of the Rock River.

In 1867 General Wilson reported that the Rock River even without the aid of storage reservoirs would furnish sufficient water for a canalized river having locks of even greater dimensions than those of the Illinois and Mississippi Canal (170 by 35 by 7 feet.)

In 1913 the United States Engineers submitted a report on the survey made in 1912 and 1913 in which it is stated that between Janesville, Wisconsin and Sterling, Illinois, there are six power dams not provided with locks and that there were 41 bridges. The dimensions of the locks proposed are 310 feet in length and a width of 35 feet and a depth on lower sills of 7 feet.

Many of the bridges would have to be changed so as to give a proper clearance for the modern type of barge and locks be built in all dams.

With the construction of dams and bridges the usefulness of the river for navigation was restricted to the areas between the obstructions.

The rapids in Rock River at Sterling and Rockford interfered with water transportation in seasons of low water, and many Companies were formed to build dams and canals to overcome this handicap. Some of the dams were built but the cost of canals to be cut through rock was prohibitive in those days, when capital was difficult to interest in public works.

The State Legislature on February 27, 1841, approved the project of the "Rock River Navigation Co." to remove "such obstructions to the navigation of said river" "by building dams, locks, canals and the creation of slack water navigation." This was only one of the many similar legislative acts.

All of the dam projects approved in early times required the construction of locks in all dams, as public opinion approved the idea of using the streams in the State for water transportation. The Grand de Tour Company was the pioneer in the manufacture of plows in Illinois and on March 4, 1843 an Act was approved to authorize them to erect a dam "across the North Branch of Rock River to the Island opposite the town of Grand de Tour * * * provided said dam shall not interfere with the free navigation of said river."

With the construction of the C. & N. W. Ry. touching the river at Dixon the long haul to the railroad of raw and manufactured material caused the removal of the Grand de Tour Co. to Dixon where it is still in existence. From the time the dams were built the value of the Hydaulic works have been recognized and the following table shows that the water power is slowly being developed, but with the increasing cost of fuel, the small amount of water power now being developed, will be greatly increased.

WATER POWER DEVELOPED ON ROCK RIVER, 1924.

Location.	Available head.	Average H. P. developed.	Products.	Remarks.
Rockton	10	694	Tar products	
Rockford	7 to 10	3975	General manufacturing.	Represents 15 plants
Oregon	7	956	Electricity	
Dixon	7	*432	Electricity	New plant built 1935
U. S. Dam	8	2500	Electricity	
Sterling and Rock Falls	8	2100	General manufacturing.	Represents 11 plants
Sears	13	2179	Electricity	

* No report made on H. P. now developed.

John H. Buker, 2016 Harlem, Rockford, Illinois, 75 years old, had lived in Rockford since 1855, and has been interested in navigation on the Rock River. He says that the "Arrow" was built in Jamesville, Wisconsin in 1889, and bought by him in 1900 and brought to Rockford and used as an excursion steamer. It was about 65 feet in length, single deck and had two screw propellers. He had been told that in 1847 the "Gypsy" came up from the Mississippi River to Beloit, Wisconsin, with a general merchandise cargo.

The "May Lee' of Rockford was about 65 feet long and had a beam of 12 or 14 feet. This was a "double decker" and later was remodled enlarged and renamed the "City of Rockford" about 1919. This boat has a flat bottom and stern wheel and about 141 feet in length and a width of 28 feet with a 3-foot draft. A picture of this steamer appears herewith.

Mr. Frank Schram, 124 N. Main St., Rockford, principal owner says that 500 passengers is an average or ordinary load. The boat is principally used for excursion purposes and in average stages of the river they go up stream as far as Latham.

HISTORY OF ROCKFORD, 1834-1861.

Church.

Chapter 37, page 188.

Transportation: Navigation of Rock River, etc

January 11, 1840, a meeting of the citizens was held at Rockford to consider the expediency of asking Congress for a grant of unsold lands in the Valley of Rock River, the proceeds to be applied to the improvement of the stream. Among the resolutions was one that Congress be asked for an appropriation of 150,000 acres of public land. No action taken by Congress.

February 28, 1844 the "Rockford Forum" stated that the Steamboat "Lighter" from St. Louis on opening navigation in the Spring would ascend the Rock River. The "Forum" advised the citizens to make exchanges of grain for provisions. The "Lighter" arrived in Rockford the latter part of June and on July 1st it made a trip to Roscoe.

February 28, 1843 an act was passed to incorporate the "Rockford Hydaulic & Mfg. Co." The company was given the right to construct a dam and raise the water not more than 7 feet. The company was to be required to erect and maintain such locks as might be necessary for the passage of steam boats drawing 3 feet of water. Specified rates of toll were to be charged and to detain vessels until the tolls had been paid.

In 1845 the Legislature amended the Act of 1843. The first dam was built a few rods above the present waterworks and completed in 1845 and was constructed of brush and logs and was washed out in 1851.

A paper read before the "Twilight Club" said "The Star" Janesville, Wisconsin, November 29, 1908, that in June 1836 the first steam boat arrived in Janesville from the Mississippi River. Later the boat returned to the Mississippi River.

Three years later another boat came up the river as far as Jefferson. In 1840 a company was promoted for the building of a boat in Janesville. Soon after the trial trip the promoter "Skidooed down to the Mississippi River leaving the stockholders in the lurch."

On July 4, 1844 a steamboat 130 feet in length, from St. Louis, arrived in Janesville, Wisconsin. The boat took on a large number of passengers and proceeded up stream to Fort Atkinson where they where stopped by a bridge across the river. The bridge was too low to permit the boat to pass so a bent was removed from the bridge when the boat went on to Jefferson and remained all night. The boat remained here at Janesville running

excursions and in the Fall returned to St. Louis. This ended navigation in this vicinity due to dams and bridges across the stream.

In 1866 Congress authorized the Survey of Rock River. Major General James H. Wilson had charge of the survey and it covered the route from Fond du lac to Rock Island, 285 miles of which 117½ miles would be canal fed from Lake Horicon and 187½ miles slack water navigation. The locks were to be 30 feet by 200 feet.

UNIDENTIFIED CLIPPING.

"J. H. Davey, Rural Route No. 1, tells of building the Steamer Rockford." It was built on the river bank on the site of the present city waterworks in 1857. The contractors were Steven Inman and the owners were Potter & Finnick of Rockford. The boat was a double decker with side paddle wheels and plied above the city for four seasons, trafficing among pleasure seekers. Later it ran between Dixon and Oregon, doing the same sort of business.

After being badly damaged the machinery was removed and the hull used for a ferry boat. When ruming between Oregon and Rockford it carried many loads of wheat to the mills at Rockford.

In 1857 the Steamer Rockford advertised a schedule of regular trips to Rockton on Tuesdays, Thursdays and Saturdays, leaving Rockford at 7:00 A. M. and arriving at Rockton at 11:30 A. M. Leave Rockton at 3:30 P. M. and arrive Rockford at 6:00 P. M. "Passengers landed at intermediate points."

"Freight of all kinds taken on reasonable terms."

Rockford July 1, 1857, Pennock, Sterling & Co.

The Rockford Gazette Saturday June 16, 1883. Printed a letter from the late Dr. George Haskell.

"My first visit to Rockford was in November 1837. I returned to Alton to spend the winter. April 1838 I embarked at Alton on the "Gypsy" a small sternwheel boat. I shipped 16 tons of furniture and merchandise for a store and beef, pork and flour as supplies for the new settlers. I intended to land at Savanna and team across to Rockford, but induced the Captain to make the trip up the Rock River and he consented after going to Galena and leaving the freight intended for that city.

Monday May 1, 1838 we entered the mouth of Rock River and reached Prophetstown in the evening and remained all night. May 2nd by noon we struck the Sterling Rapids. Took all day to unload the freight and haul up above the rapids.

May 3rd, again on the way and reached Dixon and spent most of the day.

May 4th, took the circuit of Grand de Tour and passed on to Oregon. Near night arrived at Byron. Took on passengers as we also had done at Dixon. Passed the night between Byron and Rockford.

May 5th, passed over the rapids and landed in front of the store then occupied by John Platt and where my freight was landed. A company of about 100 of the settlers chartered the boat for a trip to the mouth of Pecatonica River. They returned next morning. The Gypsy then returned down the river and this was the last boat to come up and return on the Rock River. One boat came up as far as Dixon with Supplies for the Army during the Blackhawk War. A boat was built in Wisconsin and came down the river but could not return."

ROCKFORD REPUBLIC.

July 21, 1895.

The Gypsy was 100 feet long and 30 feet wide. It had a cabin above the hold and an open uncovered upper deck and several state rooms. In 1869 a brother of Orlando Clark built a boat propelled by steam which was about half the size of the "Mary Lee" and was used as an excusion boat. After Clark's boat came a number of smaller steamcrafts, but the most important was the "Queen." The "Mary Lee" was built to eclipse anything at that time steaming on the rivers but hardly was the new worn off that boat when the "Illinois" was put under construction to be the largest boat on the river.

Unidentified Rockford clipping says that in 1844 a steamer came from St. Louis, the "Lighter" with a cargo. July 1st this boat made a trip to Roscoe.

A boat named the "Transit" was built that remained in the excursion trade for many years. It was a side wheel steamer and carried "good sized crowds." Band concerts were featured. About the time Harlem Park was opened in 1889 or 1890 the "Arrow" was launched. Early in the ninties W. F. Huffman brought a "Lake boat" to Rockford and named it the "City of Rockford."

The "Queen" was the next craft. The "Mary Lee" followed the "Queen" and was the first of that type here. Eventually the traffic became greater than she could handle and the "Iillinois" was built. About this time the "Mary Lee" was cut in two and a middle section added making her one-half longer.

The (Rockford) Republic June 16, 1919 shows a picture of the "City of Rockford" as the rechristened boat "Illinois" will appear under the ownership of the Rockford Excursion & Amusement Co. The Illinois was captained by Mr. John T. Buker.

The (Rockford) Star May 30, 1919 says the Steamer Illinois may be sold for the Mississippi River trade, so says Mr. John T. Buker. The Illinois was built in 1900 by Mayor A. Hutchins and Mr. Buker. After Mr. Hutchins' death in 1917 Captain Buker purchased the other half interest. These two men also owned the "Arrow."

Rockford Morning Star July 6, 1919, announces the purchase of the "Illinois" by the Rockford Excursion & Amusement Co. and that a large amount is spent on overhauling the same.

INTERVIEWS WITH RESIDENTS ALONG ROCK RIVER AT BYRON.

Mr. J. S. Kosier, 94 years of age, said that Columbus Marshal of Oregon was the owner of the boat "Blance Douglas" and hauled grain and merchandise between Oregon and Rockford.

In the latter forties or early fifties John White and John Smith built a boat and loaded same with cattle and grain and went down to the Mississippi River and sold out near New Orleans. Byron had railroad connections before either Oregon or Rockford.

Mr. Peter Hart, 89 years of age, born at Byron and a resident during his entire life said that about 1861 or 62 Captain Hill of the "General Scott" ran the boat between Oregon and Rockford transporting wheat, corn, oats to the mills at Rockford. Also carried general merchandise. This was a stern wheel boat. About 30 to 40 years ago a passenger boat was built at Oregon by Fred Jones and Edgar his son. The captain was Sam Sutton. Later the "General Scott" was floated over the Oregon Dam and taken to Dixon and was continued in the excursion trade. Later the boat was converted into a scow for hauling rock to build the dam.

Mr. J. W. Gill, Byron furniture dealer, remembers the "General Scott" as an excursion steamer. In a history of Ogle County, Illinois, in the possession of Mr. Gill, published by H. F. Kott & Co., Times Bldg., Chicago, 1878, Page 483 in foot note a reference is made to the "Gypsy" in April 1838 making a trip from the Mississippi River. "In July 1844 the 'Lighter' ascended the river as far as Janesville, Wisconsin. This boat made two or three trips, mostly as a freighter."

AT OREGON.

Mr. C. S. Haws said that in 1896 the Steamer Oregon ran for two seasons above the Oregon Dam, carrying excursions and had a capacity of about three hundred passengers.

A Mr. Coolidge in the employ of the C. B. & Q. Ry. Co. was interested in creating an interest in combined railroad and steamboat excursions.

Mr. Chas. D. Etnyre, 66 years of age, remembers the "Ober" an excursion boat at Oregon.

Mr. E. B. Jones, Secretary and Treasurer of the Jones Piano Company at Oregon, said that about 1873 the "Oregon," a stern wheel boat, was in the excursion trade for two seasons at Oregon. That his father built a boat

about 45 feet in length that carried from 35 to 40 passengers. This was a crude oil burner.

Mr. J. B. Phelps, a painter, 69 years old and born in Oregon, remembers the "Blance Douglas"—Captain Sam. Sutton, operating between Oregon and Rockford carrying passengers. He further said that Captain Fogleman, ran a boat to Rockford but could not remember the name of the boat, this was about 60 years ago. Also that Captain Folgeman used to raft logs to the sawmill at Oregon for a man by the name of Week, owner of the logs.

Mr. B. Phelps, painter, 75 years old, remembered the "Blance Douglas," Captain Sam. Sutton in about 1874-5. Mr. Phelps has lived in Oregon since 1861. Says Sutton also rafted logs to the saw mill at Oregon. Folgeman later moved to Daysville, below Oregon on the Rock River.

Mr. W. C. Andrews of Grand de Tour, 70 years of age, possesses a bill of lading from a steam boat called the "Lightener Keel" which transported steel and iron from St. Louis to Grand de Tour arriving at latter place July 29, 1844. The rate charged was 50 cents per 100 pounds. Mr. Andrews said a boat was built at Grand de Tour but could not recall the name of same. Mr. Andrews thought that he might remember the name and also other data after giving the subject further consideration.

(Copy.)

March 18, 1924.

Mr. John D. Arey,
Care Mrs. Merritt Greene, Sr.,
Marshalltown, Iowa.
Dear Sir:

Many years ago when I was a resident of Sterling, Illinois, I was acquainted with you and also when you were the Engineer of the West Park System. At present I am an Engineer in the Division of Waterways, State of Illinois.

Last fall the Department undertook to collect data as to early navigation on the rivers of Illinois.

When a small boy I recall seeing, what I then thought was a great big steamboat on which Flavel Simonsin was Captain and a Mr. Thomas pilot—at least that is my recollection.

Mr. Walter S. Stager told me he was quite certain that it was in 1865 that the "City of Sterling" was operating, in the reach of Rock River, below Sterling and among other commodities was hauled cord wood, coal and grain and at "Fair times" was used as an excursion boat.

I know of no one else that is so well qualified to give the information as yourself and if you will write me giving the names of the boats that navigated the Rock River, the year and the principal goods which the boats handled, size of boat and kind of propeller or wheel. Early histories of Winnebago and Ogle counties tell of steamboats arriving at Rockford and Oregon in the "thirties" and "forties" and refer to the difficulty of navigating the rapids at Sterling.

The Division of Waterways, among other duties, opposes any work in the streams of this State that will lessen the flood capacity of same and the defense made in some cases is that the stream has never been navigable in fact.

The United States Supreme Court about a year ago in the case of the People vs. The Economy Light & Power Co. stated that a stream once navigable is, in law always navigable.

This is a pretty long letter for an introduction but I expect that you will pardon my intrusion into your privacy and at your convenience give me the pleasure of a reply in full.

Your son, F. C. Arey, gave me your present address after I had failed to locate you in Chicago.

With sincere wishes for your health and happiness, I am

Very truly yours,

H. C. Alexander.

(Copy.)

Marshalltown, Iowa, March 19th, 1924.

H. C. Alexander,
Chicago, Illinois.
Dear Friend:

Your letter came this morning, and I will try and give you the best of my recollections of the early days of my life that I spent on Rock River. My father left Cape Cod, Massachusetts, with his family, a wife and five children of whom I was the oldest, on the first day of April, 1844. On the first day of May we landed on the south bank of the river opposite Sterling and went to live in a house that was built for a hotel in 1837, and is now standing on Fifth Street in Rock Falls, the oldest building in either Sterling or Rock Falls. The summer of 1844 was a very wet season; and the water in the river was very high. There were two sternwheel steamboats that made several trips from St. Louis to Janesville, Wisconsin; I do not remember the names of the boats, but they appeared to be of the size of most of the boats of that character then running on the rivers in the west. The same boats the next summer came up as far as the rapids at Sterling, but the river was so low that they could not get over the rapids as there was not over eighteen inches of water in a great many places above the smooth rock bottom; a large part of their cargo was flour in barrels, a great many of which they threw overboard in their vain attempt to go up the river; for one or two years afterward the boats came up the river to the foot of the rapids, but never tried to go above them. About that time a dam was built across the river at Milan, a town about three miles southeast from Rock Island, and that closed Rock River for all Mississippi River boats. The lower dam at the foot of the rapids at Sterling was built in 1855. The dam at Rockford was built a year or two before and the dam at Dixon soon after. All the boats on the river after that were built for use for pleasure excursions. I remember the boat that you mention and that they occasionally used to take on a cargo of some kind of freight, but never made it a paying business.

Let me hear from you again.

Very truly yours,

(Signed) John D. Arey,
503 South Twelfth Street, Marshalltown, Iowa.

Likewise the Fox River carried on some commerce in the early settlement of this State, and for a time it was looked upon as one of the water routes connecting the Great Lakes with the Mississippi Valley. Some notes on the early navigation of the Fox River have been prepared by Mr. D. L. McKown of this office, whose report is herewith appended.

NAVIGABILITY OF FOX RIVER.

The Fox River has its source in the northern part of Waukesha County, Wisconsin, and flows in a southerly direction to Aurora, where the course changes to the southwest and continues in this general direction to Ottawa, where it empties into the Illinois River. The total length of the Fox River is approximately 140 miles; the river from the State line to Ottawa is about 115 miles and the distance from the McHenry Dam to Ottawa is 97.80 miles.

There are quite a chain of lakes in the southern part of Wisconsin and in the northern part of Illinois and numerous creeks tributary to the Fox River. The principal lakes drained by the Fox River in Illinois, are Channel, Catherine, Grass, Marie, Fox, Long, Round, Nippersink, Pistakee, Zurich and Crystal.

The Fox River is crossed by 56 bridges within the State of Illinois. There are numerous boat clubs in the Lake Region and in the towns along the river. It is estimated that there are in the neighborhood of 5,000 motor driven boats on the Fox River and in the Lake Region.

Water power companies all along the Fox River, by taking more water than allowed, have lowered the water to such an extent that many motor boats south of Algonquin are out of commission.

The Fox River and many of the larger lakes connected with it, were originally surveyed and platted as navigable waters. In 1840 the Illinois legislature declared the Fox River navigable from Ottawa to the northern boundary of the State.

When the Fox River Valley was first settled the river was the principal highway for the Indians and the white settlers. The four main traveled water routes from the north were from the lakes by portage into the Wisconsin and down that stream into the Mississippi; also by way of the Calumet and DesPlaines to the Illinois and Mississippi; also via the Kankakee to the Illinois and via the Fox River to the Illinois. That these water routes were considered of great importance, as well as the other navigable streams, is attested by the clause in the Ordinance of 1787 when the Union was formed, which says: "The navigable waters leading into the Mississippi and the St. Lawrence, and the carrying places between the same shall be common highways and forever free as well to the inhabitants of the said territory as to the citizen of the United States, and those, if any, other states that may be admitted into the Confederacy, without any tax, import or duty therefor."

That the Fox River was considered an important highway for many years after the passage of the Ordinance of 1787 is borne out by the movement in 1846 to connect the Fox River with Lake Michigan by a canal at the upper reaches in Wisconsin, and to open the Fox River itself by dredging, etc. Public meetings were held in northern Illinois and southern Wisconsin to discuss the feasibility and importance of this project. The citizens of Kane County, Illinois, held a meeting at Geneva, June 6, 1846, and adopted a report that the interests of the people required better means of communication with Lake Michigan, and expressed their conviction that it was possible to make the Fox River navigable; that the cost of constructing locks and dams could be partly paid by sale of water power and the balance easily made up by the citizens, and that if the river was opened the people of Wisconsin would connect the river and Lake Michigan by a canal. They also stated that the distance by this project would be less than by the Fox River feeder and the Illinois and Michigan Canal. They concluded that the expense of transporting the last crop of wheat at 10 cents per bushel would be enough to open the river to the south line of Kane County—a distance of 60 miles. In 1845, the report continues, the average yield of wheat per township equaled 39,640 bushels, and in the 100 townships affected by the proposed improvement, at 37½ cents per barrel, by 1849 the revenue would amount to a total of $300,000 on wheat alone.

One June 27, 1846, a similar meeting was held by the citizens of McHenry County, and they also passed a resolution strongly endorsing this project. On August 10, 1846, the citizens in the Fox River Valley in Wisconsin held a public meeting at Rochester and enthusiastically adopted resolutions favoring the scheme.

The history of these meetings shows that the river was held in high esteem as a highway as late as 1850, and probably some time thereafter.

The most pretentious attempt at river navigation was made shortly after the close of the Civil War. Octave Leundry secured a charter about 1867 to navigate the Fox River from the mouth to Elgin. The exact name of this company is not known, and the charter has disappeared. A steamboat of about 20 feet beam and 60 feet long was built and launched above the dam at Aurora. This boat was named the "Mayflower" and was operated for several years from Aurora to Batavia. It was the intention to run between Aurora and Elgin, but the owners of the Batavia dam refused to put in locks or an incline so that the boat could get past, and the trip was limited to the distance from Aurora to Batavia. This boat was provided with wheels on the sides so that it could be dragged over the dams. Many people now living remember it and some old pictures of it are still treasured by residents of Aurora. Leundry sold out June 30, 1877, to his partner John St. Martin, and later Martin sold the boat and it was taken to the Fox Lake Region. The name was changed, and it was operated in that dis-

trict. Old residents of McHenry remember when the Mary Griswold made regular trips in the 70's and 80's, and it is very likely that this was the old "Mayflower".

The first railroad built in the Fox Lake Region and in the neighborhood of the northern portion of Fox River in the State of Illinois was the "Geneva branch of the Chicago and Northwestern Railroad." This branch was built about 1854 and run through McHenry, then a very small town in the heart of a farming community.

From McHenry up the Fox River and through the chain of eight lakes —"Fox Lake Region" the people in the early days received all of their supplies by railroad to McHenry and thence by steamboat to place of destination.

Up until about 1885 the only means of transportation to the Fox Lake Region was by wagon and boat lines operated from McHenry. The C. & N. W. Railroad sold a railroad ticket with a coupon good for the boat transportation, and in 1885 when the Wisconsin Central Railroad started to operate trains through Lake Villa the Railroad Company sold through tickets with two coupons—one good for the bus line that ran from Lake Villa to the East shore of Fox Lake, and one coupon good for passage on the steamboat line to any place in the "Fox Lake Region". Captain Hill operated the first steamboat line when the railroad came through; later Oliver Lippincott operated this steamboat line. Passengers, freight, express, etc. were carried by these boat lines.

Albert I. Hill, Assistant Station Master, C. & N. W. Railroad, and Percy E. Hill, in charge of the General Offices of Building, C. & N. W. R. R., 212 W. Jackson Blvd., Chicago, are sons of Captain Walter Hill who ran a boat line from McHenry north up Fox River and the Fox Lake Region to the Wisconsin State Line, both sons worked on Captain Hill's boats. Captain Walter Hill, deceased, settled in McHenry in 1878 and that same year started to operate a boat line. The names, sizes, year of commission, etc., of the boats operated by him are as follows:

"John S. Field" stern wheel steamboat.....40 ft. long, 12 ft. beam 1878.
"Mary Griswold" stern wheel steamboat.....60 ft. long, 14 ft. beam 1875.
"Lotus" side wheel steamboat.....50 ft. long, 15 ft. beam 1880.
"Mamie" screw propellor steamboat.....40 ft. long, 11 ft. beam 1883.

These boats ran on regular schedules, cooperating with the C. & N. W. Railroad; carried passengers, freight, express, mail and general merchandise; bulky articles, such as barrels of oil, lumber, etc. were loaded on scows and towed by the steamers on their regular trips. The "Lady Catherine", a steamboat, carried passengers, freight, express, etc. north from McHenry up Fox River and in the Fox Lake Region as early as 1854. The "Lady Catherine" was later taken to Geneva Lake.

The Steamboat "Athlete" was built in 1870 by McHenry citizens, run on Fox River and Fox Lake Region; carried passengers, freight, express, etc.; later this boat was taken to Wilmot and run on Fox River, Wisconsin.

The Steamboat "Emmerson", sidewheel steamboat, built by O. W. Owen about 1873, made regular trips, carried passengers, freight, express, etc.; ran north on Fox River and in the Fox Lake Region.

Considerable information was obtained from Ben Lippincott, owner of the "Lippincott Hotel", a forty-five room house built by his father, Oliver, in 1884. The lumber for this hotel was hauled by wagon from Waukegan and the millwork made in Chicago, shipped by freight to McHenry and thence by scow to Fox Lake. The Lippincott family came to Fox Lake about 56 years ago, 1869, and were one of the early settlers in the lake region.

The Wisconsin Central Railroad, now called the M. St. P. and Sault Ste. Marie R. R., was built through the northern part of the State and east of the "Fox Lake Region" about 1885. This being nearer the "Lakes" the people living or having summer homes on them took this railroad to Lake Villa Station, thence by Stratton Bus Line to the east short of Fox Lake, and Lippincott steamers to place of destination. The railroad company issued through tickets with coupon for bus and steamer.

The bus and steamer lines ran on regular schedules and carried passengers, express, general merchandise and mail which was transferred to them by the Railroad Company. The following are the names of the steamboats which were owned by Oliver Lippincott: the "Bennie" and the "Alice," each about 40 feet long with capacity to carry 60 passengers, general merchandise, mail, etc. The "E. J. L." about 120 feet long, carrying 200 people, general merchandise and mail.

Bert Dunnill, and his brother, Harry Dunnill, were born in the Fox Lake Region. They were "market hunters" for years and state they would frequently stop the steamers and transfer two or three boatloads of ducks or fish which the steamer hauled to McHenry and transferred to the railroad to be shipped to Chicago. Bert and Harry Dunnill still live in Fox Lake.

Bert Stanley, who was born at Fox Lake, says the side wheeler steamboat "Emmerson" was running on Fox River and Lakes prior to the "Athlete", "Lotus", "Griswold", and "Mamie". The "Emmerson" carried passengers and general merchandise. Mr. Stanley ran the "Griswold" for nine years, caried passengers and general merchandise and ran on a regular schedule making all trains at McHenry; at one time the Chicago & Northwestern Railroad sold through tickets at Chicago with coupon for boat transportation to Fox River and Fox Lake points.

The above "Old Timers" remember the steamboats "Athlete", "Lotus", "Emmerson", "Mary Griswold", "The Mamie" and the steaboat line operated by Oliver Lippincott in connection with the "Soo Line" and "Stratton Bus Line". They say in their time these boats carried passengers, freight and mail.

Everett Hunter has lived in McHenry for about 34 years and is owner of the "Hunter Boat Line" and the "Everett Hunter Boat Co.", established 1902. Mr. Hunter remembers the stern paddle wheel steamboats, "The Mary Griswold" and the "The Lotus". He says these boats carried passengers, freight and express.

The "Hunter Boat Line" has been running passengers, freight, express and excursion boats since 1902—running up the Fox River From McHenry, in the Fox Lake Region, and to the Wisconsin State Line.

"The Gladola," "Gladdin I" and "Gladdin II" run on a regular schedule, carry passengers, freight and express; they make all points on Fox River, north of McHenry, Lakes Pistakee, Nippersink, Fox, Petite, Marie, Channel, Catherine, also up the Fox River to the State Line.

Excusion boats of the "Hunter Line", "Gladful", "Gladys", "Sea Foam", "Little Chief", "Elsa" and others carry excursionists from McHenry to the State Line.

The "Hunter Boat Line" contemplates putting into commission soon, several boats that will make regular scheduled trips carrying passengers and merchandise from McHenry south to Algonquin.

"Koeppes Boat Line" at McHenry now operates a number of excursion boats on the Fox River, and Pistakee, Nippersink, Fox, Petite, Bluff, Grass, Long, Marie, Channel and Catherine Lakes.

"Pyriotte Boat Line" at McHenry now operates two excursion boats on Fox River and in the "Lake Region".

"Schmitt Boat Line" at McHenry now operates two excursion boats on Fox River and "Lake Region".

"Wm. Daimer Boat Line" at McHenry now operates seven boats, passenger, express and excursion. Public landing, southeast shore Nippersink Lake. Meet all Chicago, Milwaukee & St. Paul trains. Run to all points on Fox River north of McHenry and all the lakes in the "Lake Region".

Wm. Althoff, McHenry, was born at Johnsburg on Fox River. His father runs a general store at Johnsburg, and during the years of 1913 and 1914 Althoff Jr. took orders and made deliveries by motor launch of groceries, etc., on the Fox River north of McHenry and on Pistakee Lake. Anton Snyder and Ben Stilling, who were in the grocery business at the time took orders and made deliveries by motor launch. Martin S. Friend. John H. Friend and other farmers, living on Nippersink Creek, as late as 1908 and 1909, used to club together, load a scow with wheat, pole down the

creek, across Pistakee Lake and down the Fox River five miles south of McHenry where they would meet it with empty wagons and haul the grain to a mill at Wauconda.

Spring Grove on Nippersink Creek was settled by people from Johnsburg who moved their housegoods by boat over Pistakee Lake and up Nippersink Creek.

In 1921 a house was built on the Fox River, and there being no road to get to where the building was to be erected, the lumber was hauled by wagon to the Johnsburg bridge, then loaded on a scow and floated down stream to place of building.

In 1922 when the McHenry Dam, 3 miles south of McHenry was being repaired, coal, lumber, piling and all material used was sent down the Fox River by barge from McHenry.

In 1922 there were 562 motor boats enrolled in the Fox River and Lakes Improvement Association. In 1923 about 700 motor boats locked through McHenry Dam.

Joe Mertes has lived 44 years in the Fox Lake Region and is now running a hotel on Pistakee Bay. He stated he remembers the "Mary Griswold" and the "Lotus", two old time paddle wheel steamboats that used to carry passengers, freight and express in the early days from McHenry up the Fox River and in the "Lake Region".

Charles Kern, runs a blacksmith shop at Algonquin and has lived there for 40 years. He said the "Halligan", a side wheel steamboat, owned by a man named Cook, ran excusions about 30 years ago from Algonquin north on Fox River to Fox Lake. The "Myrtle," owned by John Janeck and Barney Stewart, ran excursions 35 years ago from Algonquin to Fox Lake Region. Mr. Kern says he thinks these boats also carried freight and express.

Dore Thomas, retired, born near Algonquin in 1852, owned water power rights at Algonquin for 10 years and sold out in 1911. He stated there were old time side and stern wheel steamboats in the excursion business years ago; they ran from Algonquin north. He does not remember the names of any of these boats. During Governor Deneen's administration Mr. Thomas started a movement to dredge the Fox River in the vicinity of Aigonquin.

Dan Duff, retired, born in Dundee in 1844, owned the side wheel steamboat "Myrtle". This was an excursion boat and ran from Algonquin up the Fox River as far as the Lake Region. The first bridge built at Dundee 65 years ago, was built out of logs cut in McHenry County and rafted down the Fox River.

Everett Snooks, born at Algonquin in 1861, now runs a hardware store at Carpenterville. He stated the side wheel steamboat "W. W. Norton" ran excursions above Algonquin in 1880. Also the "Myrtle" owned by Dan Duff and the "Bailey Boat" owned by John Bailey, ran excursions from Algonquin up the Fox River and as far as the Lake Region.

Wm. Reeh, born in Elgin in 1864, stated that excursion boats and private launches ran for a number of years above and below the dam on Fox River. The excursion boats ceased to run the last four or five years on account of low water.

D. A. McBride, lived in Elgin since 1873. In about 1885 he built a stern wheel steamboat 11 feet wide and 50 feet long, and hauled stone from a quarry, five miles south of Elgin to Elgin. This steamboat was afterwards used as an excursion boat.

Shirley Harris has been in Elgin since 1880, rents boats and is an old time fisherman. He stated the "Thelma" a side wheel steamboat, was carrying passengers and merchandise previous to 1907. Private launches and excursion boats now running north of Elgin Dam. Many excursion boats and private launches were put out of commission during the past few years on account of increased amount of water used by the Hydraulic Works at Elgin.

Joe Sierp, lived in Ottawa in 1871-1872 and in Aurora since 1889. He stated a Captain Leundry ran a stern wheel steamboat in 1868-1877; this was an excursion boat, the "Mayflower" and was in commission about 10 years, and ran south from North Aurora to Batavia. For the past 10 years excursion boats have been running from Fox River Park south to the Mont-

gomery Dam. There is now a paddle wheel excursion boat running from Aurora Hotel, Aurora, to North Aurora.

John H. Spear was born in Aurora in 1859 and now lives on an island in North Aurora. He said he remembered the old stern wheel steamboat, the "Malflower" owned by Captain Leundry and run on the Fox River from 1868 to 1877.

John Linden, retired, lived in Aurora since 1862. He remembers the old stern wheel steamboat "Mayflower" owned by Captain Leundry which ran on the Fox River in the 70's.

Old Timers in all towns along the Fox River from Aurora to Ottawa were interviewed and all said owing to dams and shallow water in the River, at no time, to their knowledge, were there any steamboats on the Fox River south of Aurora.

Water power was formerly utilized more extensively in proportion to the population than at present. The following table gives the data on the dams now in existence.

PRESENT DAMS AND POWER DEVELOPED ON THE FOX RIVER.

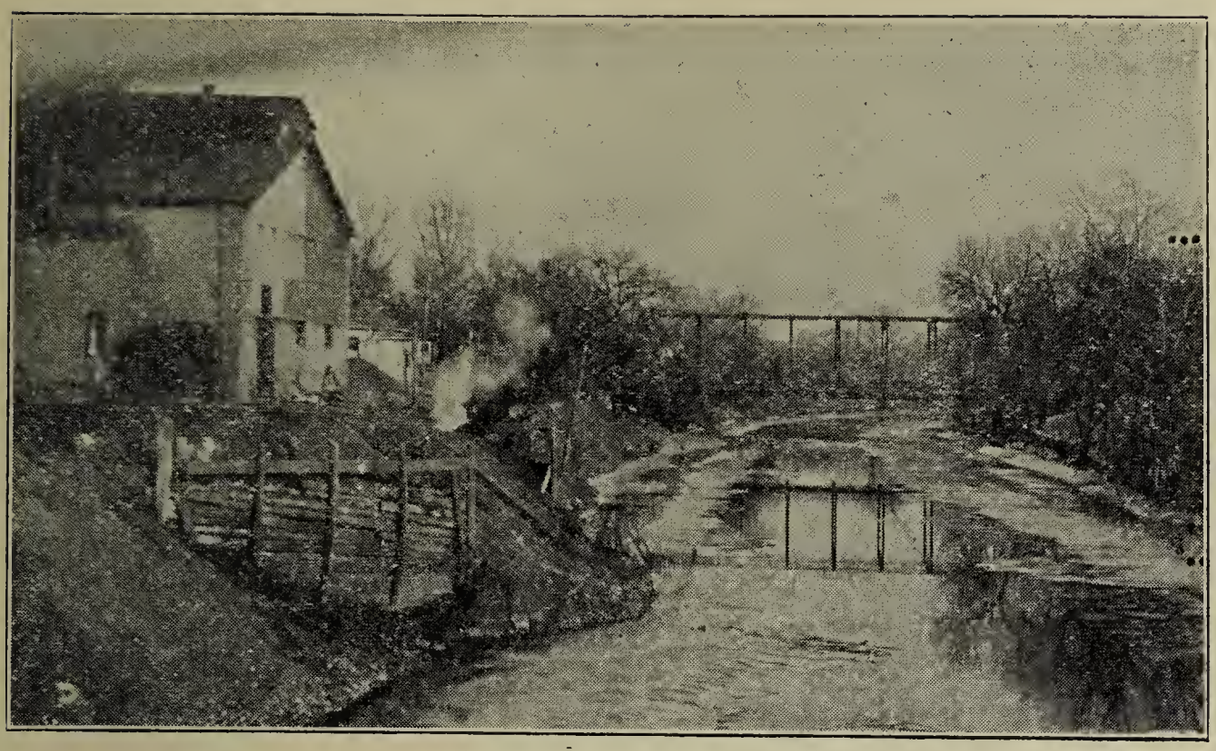
Location.	Available head.	Average H. P. developed.	Products.	Remarks.
McHenry	2.5			Used to improve navigation above dams.
Algonquin	4.0		Flour and feed	Electric current purchased for use in mill.
Carpentersville	6.0	427	Iron and steel articles	Auxiliary plant used.
Elgin	7.0	842	Dairy products and mfg	Auxiliary plant used.
South Elgin	7.0	351	Flour and crude drugs	No auxiliary plant used.
St. Charles	7.0	402	General manufacturing.	No auxiliary plant used.
Geneva	7.0	60	Sad irons	Auxiliary plant used.
Batavia	9.5	500	Wagons, windmills, machine shops and foundry	Auxiliary plant used.
South Batavia	3.0		Electric current	A. E. & C. Elec. Ry. water impounded for steam condensers.
North Aurora	7.0	135	Foundry and machine shop, planing mill and sash factory, brass foundry	Auxiliary plant used.
Aurora	6.0	80	Mfg., wood working machinery	Auxiliary plant used.
Yorkville	5.0			Mill bldgs. destroyed.
Dayton	29.7	903	Sale of electric energy	

At the McHenry Dam there is a lock for the passage of boats, in fact the only lock on the river. At all the other dams a portage must be made by boats passing these obstructions to navigation.

Signed D. L. McKOWN.

ENCROACHMENTS.

As valuable as our streams are for navigation purposes and for pleasure, private interests are often prone to encroach upon them for private gain. These encroachments are frequently made to acquire greater land for plant sites, or for sale for private gain. These encroachments lessen the efficiency of the streams to discharge flood waters and are frequently causes of ice gorges, which do untold damage to low lying property above and below the sites of encroachments. This question of encroachment on our waters is becoming a more aggravated one each year with the increasing value of property,—especially is this the case along the shore of Lake Michigan and along the rivers in the northern part of the State, which are so much in use for manufacturing purposes.



Cinder encroachment on Vermilion River.

Same encroachment as above.

The Division of Waterways has had inspectors during the past year as follows: one on the Illinois River, two on the Fox, one on the Rock, one on the Calumet, two on the Chicago River, one on the Kankakee and one on Lake Michigan, all on the lookout for encroachments and pollution. In addition to the inspectors above given, engineers are ready at any time to investigate and report upon cases of encroachment or pollution.

Encroachments are found to be of many different types. A few of them are cited herewith.

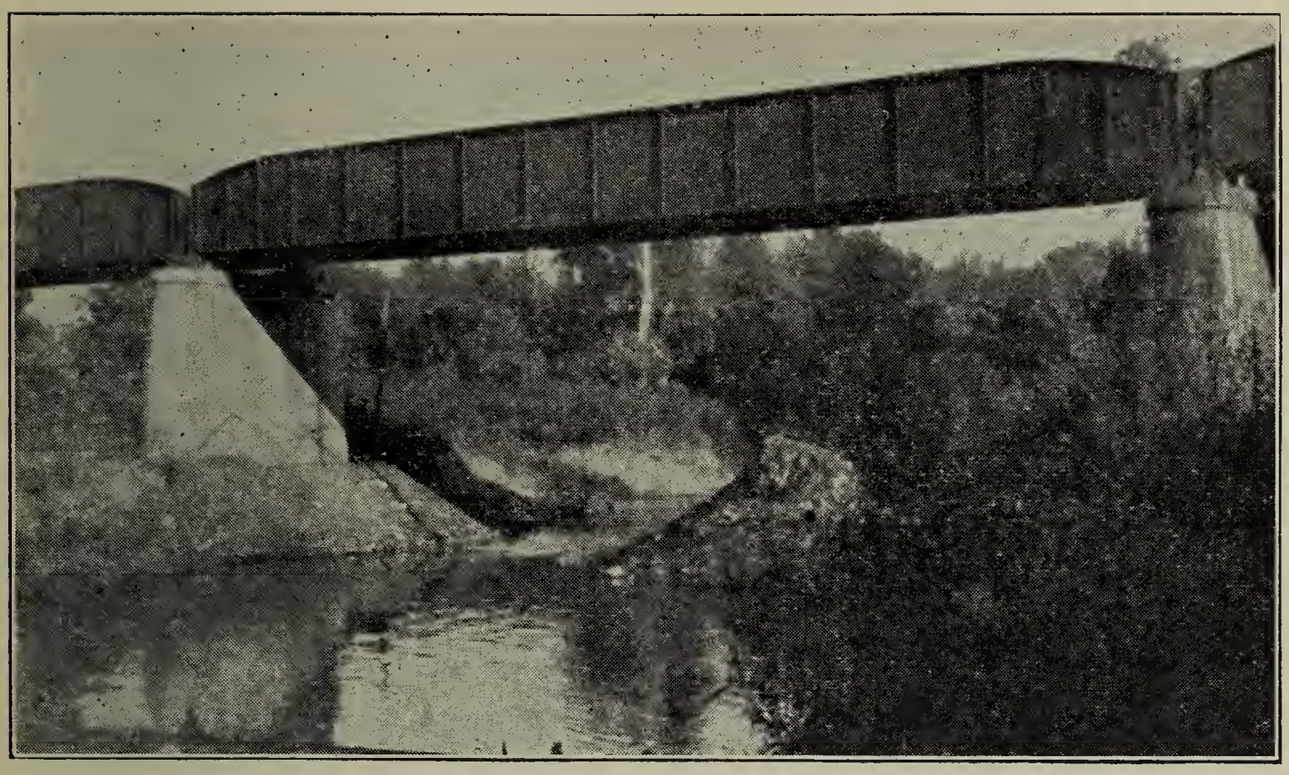
Probably the most common type occurs among the manufacturing establishments situated along the banks of streams, in which the ashes, cinders and debris of the plant are dumped over the bank into the river. This is the easiest way to dispose of them and it also gradually adds ground space to the factory site. This is of course directly against the Statutes of the State and is injurious to the stream in restricting the flood capacity. As an example of this type of encroachment see pictures on page 49. These were taken on an important stream in the central part of the State, and show a fill of cinders extending considerably in the river and partly upheld by timbers. This fill is being removed in obedience to orders from the Division.

Another type of encroachment is shown on picture on page 55 located on the same stream as the above. In this case a large pile of brush was dumped on the ice in the stream. Such encroachments as this are extremely liable to cause dams and serious obstructions to the flow of the stream, as they float down and lodge in some bridge opening or other restricted point of flow.

The pictures on page 51 show an encroachment made by a railroad in central Illinois. In this case the railroad dumped tailings from coal mines from several bridges into the stream, completely damming the stream several feet high. The intent was to let the next high water wash away the fine material and then use the coarse part for rip rapping. This also has been removed by orders from this Division.

Another type of encroachment is seen in the pictures on page 53. In this case a real estate subdivision was laid out in which some of the new streets were crossed by a small stream with a watershed area of about ten square miles. This stream is normally dry but has considerable flow in times of heavy protracted rains. While outside this subdivision bridges of 16 feet length span the stream, pipe culverts of 24 and 27 inches diameter were expected to carry the water. Such culverts would be entirely overtaxed in time of flood with consequent damage to adjacent property, and they were consequently ordered removed and replaced by open span bridges of sufficient capacity.

Another form of encroachment which is very common and has to be guarded against most carefully, occurs on the shore of Lake Michigan. The jurisdiction of the State goes to the normal water line of the lake, which line was determined and fixed by survey and plat in 1914. By construction of piers or breakwaters by property owners in the past years, and by the consequent accretion of land outside of this normal waterline as established is 1914, following the Act of Legislature, en-



River channel filled by railroad. Fill removed by order from Division of Waterways.

Same encroachment as above.

croachments have occurred at a number of places. Permits for piers and breakwaters are therefore now being closely investigated before being issued.

Another type of encroachment, and one of especially grave character, is that of the construction of levees for the reclamation of land too close to the river channel. On many of our streams drainage districts have been organized and levees constructed so close to the stream that the flood plain is very seriously restricted. In consequence when floods occur, the crest of the floods is raised and older levees are overtopped or broken, resulting in great damage to improved lands.

Encroachments of these or other types are continually being investigated by the Division of Waterways and much damage or destruction to property has been averted by its efforts to prevent the restriction of flood capacity of our rivers and streams.

WINTER CONDITIONS ON ILLINOIS RIVERS.

Streams were at a low stage during the past winter. Comparatively little snow fell and due to warm weather in February, the break-up of ice came early and gradually. No great rains accompanied the break-up. Consequently, the ice gorges were not so heavy or numerous as usual.

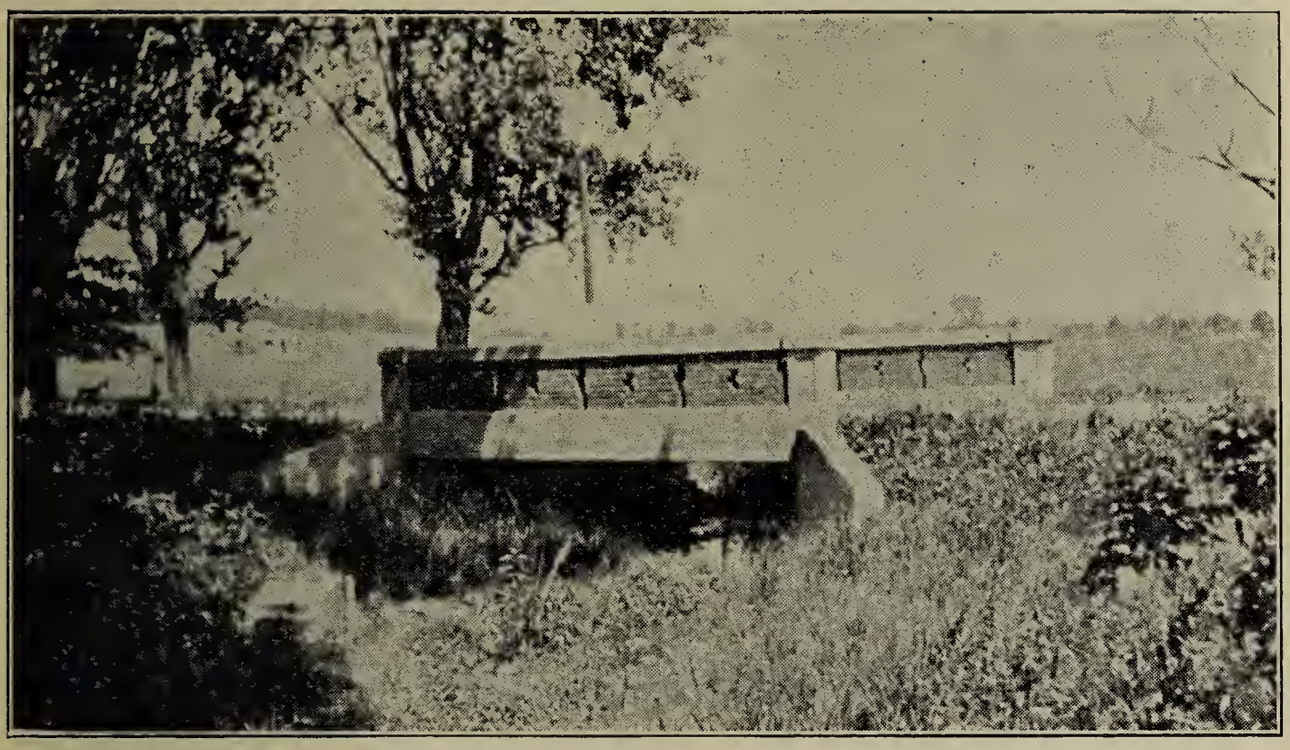
The pictures on page 59 show the gorge on the Kankakee River at Lorenzo where the C. & A. R. R. and the Santa Fe R. R. have parallel bridges about 75 feet apart.

The pictures on page 57 show the gorge at Dixon on the Rock River, one showing the condition below the Galena Street Bridge and the other above the same bridge and below the dam. In the latter picture is shown the new plant of the Northern Utilities Company under construction. The coffer dam for this work was overtopped by the water and two steam shovels were temporarily abandoned, but no serious damage done.

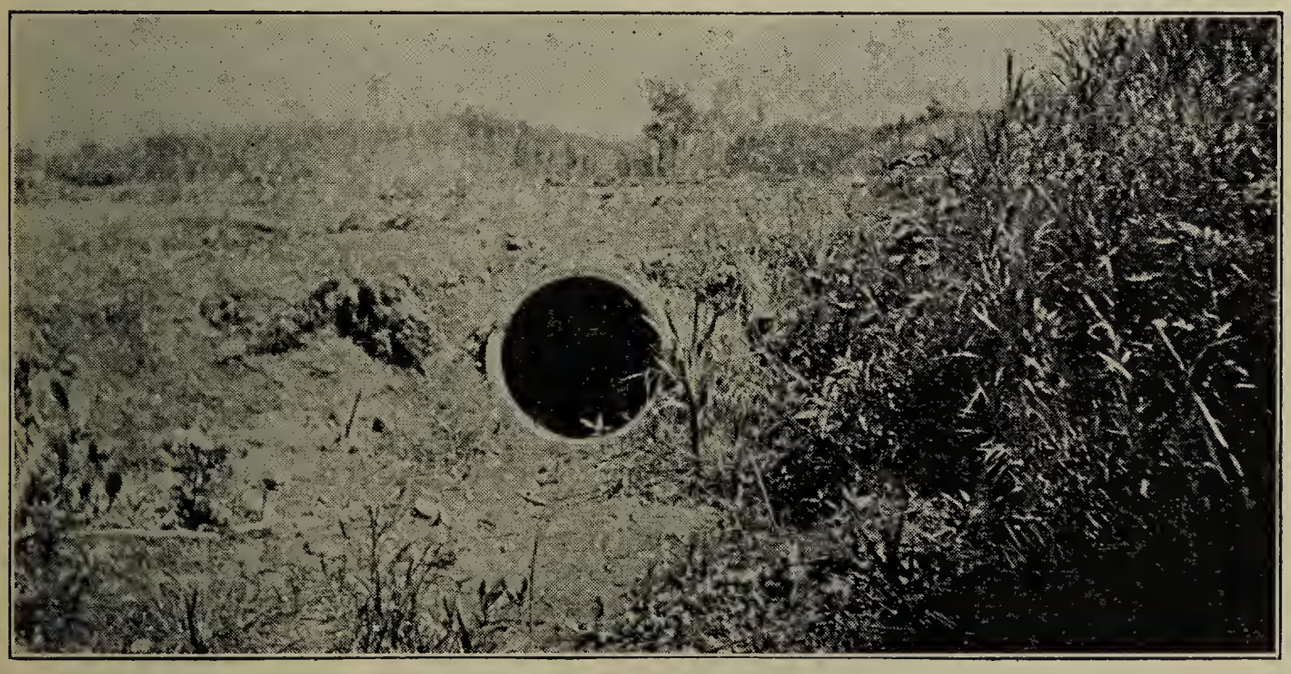
At Nelson—between Dixon and Sterling—where the gorges usually occur, no heavy gorge occurred this year.

These photographs show clearly the importance of proper design of bridges to discharge flood waters and ice during the spring freshets. Questions of economy in first cost of construction frequently influence bridge builders in designing their structures of too short span lengths with resulting unnecessary number of piers frequently not properly located. One ice gorge resulting from an improper design may cause more damage to private or public property than the entire cost of a properly designed structure.

Another cause of these gorges is the presence of low islands forming in the river channel, which islands afford places for the lodgement of ice and the formation of gorges. Such islands may be seen in the pictures of the Dixon gorges in the Rock River. In many instances these islands could be removed at small cost, and their removal would undoubtedly be a wise expenditure of public money. The improvement of some of our streams, and notably the upper Kankakee River in Indiana, has radically changed the regimen, bringing down large quantities of sand and floating debris, which find lodgement in the shallow



Sixteen-foot span bridge over small stream entering new subdivision.



Twenty-four-inch culvert supposed to carry above stream ordered removed by Division of Waterways.

places and very quickly form new islands. Each successive high water brings down additional floating material, which adds to the area of the island, Thus augmenting the danger from ice gorges, and decreases the capacity of the stream to discharge the flood waters. Such conditions require watchful attention, and if conditions become more aggravated funds should be appropriated for the removal or destruction of these islands.

STREAM POLLUTION.

Stream pollution in Illinois, as in many other States, has become so general and so serious that more and more active demand is being made by the general public that remedial action be undertaken. This demand is only too well justified for with the rapid growth of the State and its industries, the rivers and lakes are becoming polluted to a degree where fish life is destroyed and nuisances are created.

Several of the larger cities in the State have already created Sanitary Districts and have undertaken the construction of sewage disposal works. Others are at present contemplating similar programs. When this work is done some headway will have been made toward improving some of our more important streams.

But at best Illinois has but begun to awaken to the necessity for cleaning up its streams. To date the majority of its communities have indicated the belief that their responsibilities ended when the sewage was discharged into the nearest watercourse. This has been especially true along some of the larger streams which naturally, if maintained in fair condition, would represent some of the State's greatest assets.

It may not be possible, nor is it desirable to attempt to bring back the various streams to their original purity. However, the time is rapidly approaching when public opinion will demand that all communities and industries shall provide adequate treatment for its wastes, so that the streams can again support fish and other aquatic life and be suitable for various public uses.

A large number of inspections have been made during the past year, of alleged cases of pollution. These cases were not all due to sanitary sewage, but were also caused by various wastes including milk, dye, tannery, gas, oil, chemical and many other forms of wastes.

Perhaps the quickest and best results can be accomplished when public opinion in the various communities, where objectionable pollution now exists, is brought to demand that corrective measures be taken. The Isaak Walton League has taken considerable interest in the matter of stream pollution and is coming to take an increasingly active part in crystallizing public opinion toward the necessity of preserving the streams reasonably free from pollution. Assistance along these lines is at all times invited by the Division of Waterways.

In January 1925 this Department received complaints signed by Congressman Henry T. Rainey. These complaints alleged that Swift & Co., Wilson & Co., Armour & Co. and the Corn Products Refining Co. "dumped or deposited, or caused, suffered or procured to be thrown, discharged, dumped or deposited, acids or chemicals, industrial wastes or refuse, poison, effluents or other washings, deleterious to fish life, and refuse matter containing solids, into the Illinois River, said matter so

Brush encroachment thrown on ice, Vermilion River.

Encroachment on Fox River at Aurora.

discharged containing substances discoloring and otherwise polluting the Illinois River * * * ."

As a result of these complaints, visits were made to the packing plants and to the Argo Corn Products' Plant. Samples of the wastes from the Corn Products' plant at Argo were secured and analyzed by the State Water Survey. Photographs taken at the sewer outlet show distinctly the quantity of flow and its discoloring effects. The analyses indicate that the wastes from this plant alone add a sewage load to the Illinois equivalent to the domestic sewage from a city with a population of several hundred thousand.

Requests made at the packing plants that we be permitted to collect samples of their industrial wastes met with refusals. No samples were therefore collected at that time.

There can be no question as to the necessity of having these industrial wastes, as well as many others, treated before permitting them to reach the Illinois River. Such treatment will no doubt be accomplished at these plants within the next few years since this is a part of the work demanded by the Federal Government in connection with the withdrawal of water from Lake Michigan. However similar wastes are to be found going into other streams of the State and it is but a question of time until the State must require that reasonable treatment be undertaken.

The past year has been an excessively dry year throughout Illinois and neighboring States. From July 1, 1924 to July 1, 1925 the U. S. Weather Bulletin shows that the average rainfall for the whole State for nine months of the year was below normal. For the first six months of 1925, five months were below normal, the total rainfall for that period being only 13.91 inches whereas the normal is about 19 inches.

To this lack of rain is attributed the extremely low stage of water in our rivers for the past year, and to that low stage is attributed the fact that pollution has been so much more noticeable, both in creating nuisance and in effect on fish life.

Among the various complaints investigated by the Division of Waterways, one is shown here in pictures on page 61. This was a complaint of nuisance and fish killing by gas works in a small town in Northern Illinois. The wastes of this gas works, including a large amount of oil, were deposited in an open street gutter and thence through a ditch to the stream.

Another case of oil waste is shown in the pictures on page 62 taken in a very small stream running from some oil wells in southern Illinois. All oil wells have a certain amount of salt water coming to the surface with the oil. This salt water, combined with crude oil escaping either through carelessness or otherwise, renders the stream unfit for stock to drink, unsightly in appearance, and in some cases creates an actual fire danger to crops or farm buildings located along the banks.

In the pictures shown, in order to prevent as much as possible of the oil going down through his pasture, a farmer has placed a six inch board across the stream to hold back the oil.

Rock River ice gorge—February, 1925. Below Galena Street bridge.

Same gorge above Galena Street bridge. Northern Utilities Co. construction on right.

Periodically and sometimes as often as every second day, he sets fire to this oil. One of these burnings is shown when about 8 or 10 barrels of oil were burned only two days after the previous burning.

Steps have been taken to require the oil company, responsible in this case, to retain the oil at the wells in trapped ponds and use it for road oil instead of wasting it.

Creamery and dairy wastes are exceedingly liable to cause nuisance and unsanitary condition of streams, and many complaints arise from them.

Pictures on page 63 show the condition of a stream in central Illinois, one being at the outlet of city sewer, discharging dairy wastes, and the other about a half mile below the outlet, both showing the milk pollution.

Court decisions clearly hold that pollution of our natural waterways is illegal and indefensible, and those causing such pollution should be held in strict accountability for damages caused by their unlawful acts. The Supreme Court of the State of Pennsylvania has recently handed down an opinion on the "Pollution from Oil Wells." This opinion is quoted below. A similar opinion has been rendered by the Supreme Court of the State of Wisconsin relative to pollution by sanitary sewage. Excerpts from this opinion are also quoted below. In each case the Courts held that those causing the pollution are liable for any damage resulting therefrom.

Kankakee River ice gorge—February, 1925. Between C. & A. R. R. and A., T. & S. F. R. R. bridges at Lorenzo.

Same gorge above bridges.

Sewage from Corn Products Co., Argo, Illinois.

Sewer outlet from Corn Products Co., Argo, Illinois.

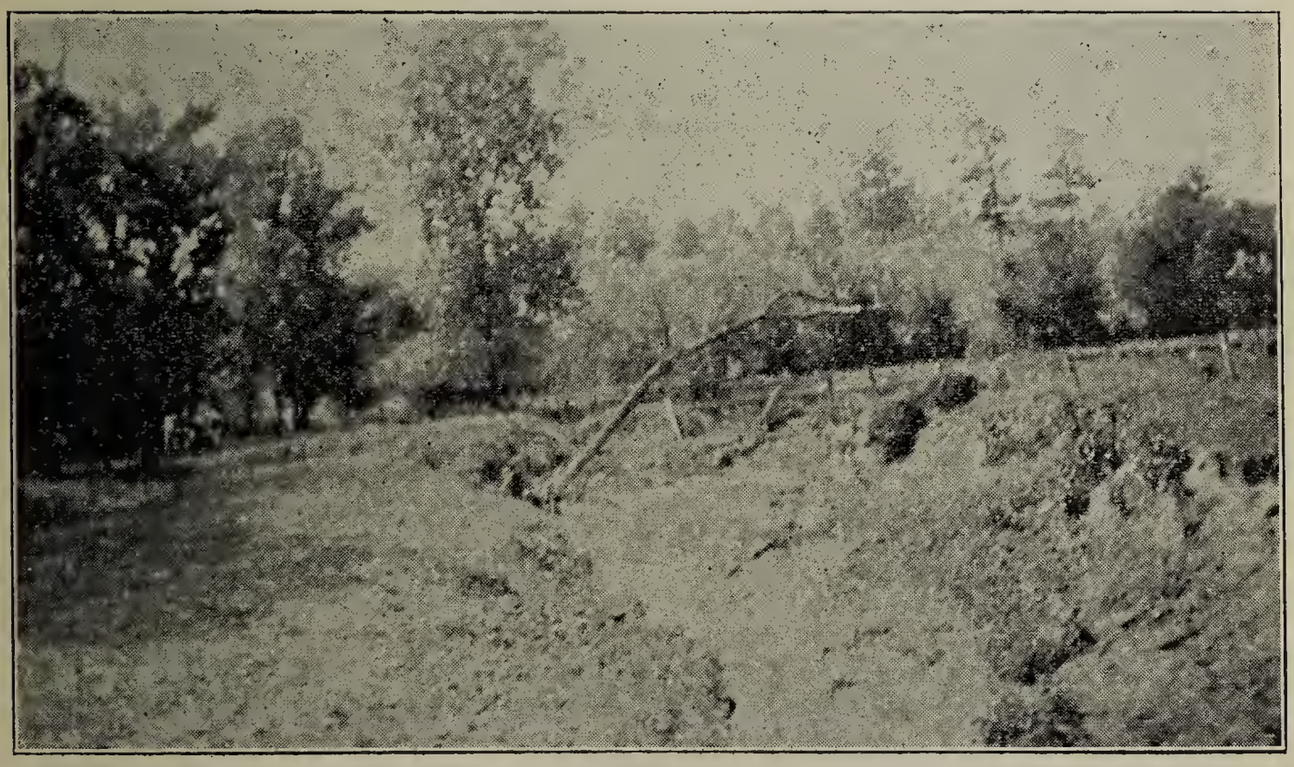
Village gutter showing oily stream from gas works.

Same gutter lower down showing danger of fire.

Burning waste oil on small stream in Waterloo oil field.

Same as above.

Outlet of city sewer showing milkwastes from dairy.



Same stream one-half mile below sewer outlet still showing milky effluent.

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IN THE SUPREME COURT OF PENNSYLVANIA, EASTERN DISTRICT.

No. 182 January Term, 1924.

The Pennsylvania Railroad Company, Appellant,

vs.

Sagamore Coal Company, a corporation; Melcroft Coal Company, a corporation; Oneida Coal Mining Company, a corporation; Indian Creek Coal & Coke Company, a corporation; Staker Coal Company, a corporation; Rogers Coal Company, a corporation; Springfield Coal and Coke Company, a corporation; Crooked Creek Coal Mining Company, a corporation; H. I. Fisher, trading as Indian Creek Valley Coal Company; George Warrick, C. S. Pore and Howard Speicher, trading as Warrick Coal Company; John I. Rogers, trading as Indian Creek Coal Company; Millrun Coal Company, a corporation; Charles P. Newell; Charles Rose; George W. Campbell, Samuel T. Steele, Charles H. Brooks, trading as Campbell Coal Company; Saltlick Coal Company, a corporation; Pennie-Bryner Coal Company, a corporation; John H. Prinkey; Rice Wilkins Coal Company, a corporation; John W. Barger; Arthur Seneff, trading as Laurel Run Coal Company; Indian Ridge Coal Company, a corporation; W. E. Rice and James J. Dougherty, partners, trading as Rice & Dougherty; Ralph Ritenour; George McMillan; William E. Rice; Simon S. Snyder; Silcox Coal Company, a corporation; Nebo Coal Mining Company, a corporation; Romeny Coal Mining Company, a corporation; and Edward H. Wingrove Ida May Wingrove, H. L. Echart, J. C. Dougherty and E. W. Austin, partners, trading as Wingrove Coal Company, Defendants,

Appeal from Decree of Court of Common Pleas of Fayette County, at No. 1023 in Equity.

No. 183 January Term, 1924.

Dunbar Water Supply Company, Appellant,

vs.

Same Defendants.

Appeal from Decree of Court of Common Pleas of Fayette County, at No. 1023 in Equity.

No. 184 January Term, 1924.

Commonwealth of Pennsylvania, ex rel. the the Attorney General, intervening Plaintiff, Appellant,

vs.

Same Defendants.

Appeal from Decree of Court of Common Pleas of Fayette County, at No. 1023 in Equity.

No. 185 January Term, 1924.

The Mountain Water Supply Company, Appellant, vs. Same Defendants.	Appeal from Decree of Court of Common Pleas of Fayette County, at No. 1023 in Equity.

No. 186 January Term, 1924.

The Mountain Water Supply Company, The Pennsylvania Railroad Company and the Commonwealth of Pennsylvania ex rel. the Attorney General, Appellant, vs. Same Defendants.	Appeal from Decree of Court of Common Pleas of Fayette County, at No. 1023 in Equity.

No. 179 January Term, 1924.

Westmoreland Water Company and Commonwealth of Pennsylvania ex rel. Attorney General, Appellant, vs. Same Defendants.	Appeal from Decree of Court of Common Pleas of Fayette County, at No. 1053 in Equity.

No. 180 January Term, 1924.

Commonwealth ex rel. Attorney General, Appellant, vs. Same Defendants.	Appeal from Decree of Court of Common Pleas of Fayette County, at No. 1053 in Equity.

No. 181 January Term, 1924.

Westmoreland Water Company, Appellant, vs. Same Defendants.	Appeal from Decree of Court of Common Pleas of Fayette County, at No. 1053 in Equity.

OPINION OF THE COURT.

Filed SEPTEMBER 29, 1924.
Schaffer, J.

The commonwealth, and the other complainants in these cases, appeal from the dismissal of their bills in equity, through which they seek an injunction against defendants, to prevent the discharge, by them of acid mine waters into Indiana Creek, in Fayette County. This stream is approximately 22 miles long, with a drainage area of about 130 square miles, and on it, at a point below defendant's mines, one of complainants, the Mountain Water Supply Company, has constructed a dam with a capacity of 251,000,000 gallons of water, and a reservoir capable of holding 6,500,000 gallons.

This discussion of the cases, both on oral argument and in the exhaustive briefs filed by able attorneys on both sides, took a wide range. In the view we take of it, the controversy compacts itself within closer bounds than it had in the minds of counsel, and although its public impor-

tance is very great, it is controlled by one fact and a single equitable principle;—the fact that the stream has been polluted and the principle that this creates an enjoinable nuisance if the public uses the water.

We do not deem it necessary to fully investigate and determine the powers and the effect of certain corporate acts of the plaintiff water companies, to which counsel have given great attention, further than to outline some of the steps which were taken. The Mountain Water Supply Company is incorporated under the 18th Clause of the second part of section 2 of the Act of April 29, 1874, P. L. 73, 74, as amended by the Act of May 2, 1889, P. L. 259, "for the storage, transportation and furnishing of water, with the right to take rivulets and land and erect reservoirs for holding water for manufacturing and other purposes, and for the creation, establishing, furnishing, transmission and using of water power therefrom." For its corporate purposes, it appropriated, by resolution, the waters of Indian Creek, as well as the necessary Lands, for the construction of dams, reservoirs and rights of way for the laying of pipes. It settled with the owners of the land apropriated and with the lower riparian owners on the stream. This company was created by the Pennsylvania Railroad Company in order to provide a sufficient supply of pure water for use in operating its trains. The railroad company has constructed and maintains a system of water facilities to conduct the water from the reservoirs and lines of the Mountain Company and to store it in small reservoirs, to be available when needed for its locomotives. This system of water facilities, maintained and used by the railroad company, comprises 131 miles of pipe lines, with ten reservoirs and four stand pipes. The cost of its installation by the water company and the railroad company was in excess of $4,000,000.

The Dunbar Water Supply Company is incorporated under the 9th clause of the second part of section 2 of the Corporation Act of 1874, P. L. 73, and its supplements, for the purpose of supplying water to the public in Dunbar Township, Fayette County. After incorporation, by resolution, it appropriated the waters of Indian Creek at the reservoir of the Mountain Company. It has also appropriated right of way necessary for the construction of pipe lines. When the improvements were completed by the two water companies, the railroad company, under the authority of the act of April 22, 1905, P. L. 264, authorizing "Railroad companies of this Commonwealth, in order to secure an adequate supply of water for their corporate purpose to acquire, hold, dispose of, and guarantee the stock and securities of water companies," purchased and acquired their entire capital stock.

The Westmoreland Water Company was incorporated September 24, 1886, as a public water company, likewise under the 9th clause of the second part of section 2 of the Act of April 29, 1874, P. L. 73, and its supplements. Its earlier corporate designation was the Westmoreland Water Company of Ludwick Borough. At the time it was chartered seven other companies were created for other districts of Westmoreland County, these municipal divisions being Greensburg and adjacent boroughs and townships. In the year 1904, each of these eight companies adopted resolutions appropriating a fractional interest in the waters of Indian Creek at a point near its confluence with the Youghiogheny River and below the dam of the Mountain Company, the sum of the appropriations representing the entire flow of the stream. Following this, each of these companies filed a bill in equity against the Mountain Company seeking to restrain the latter from diverting the water. This litigation was settled by the execution of a contract between the parties to the several suits, which provided for the furnishing of water by the Mountain Company to the other companies. Subsequently the name of the Westmoreland Water Company of Ludwick Borough was changed to Westmoreland Water Company, and it purchased the property and franchises of the other companies which had been created contemporaneously with it.

The resolutions appropriating the waters of Indian Creek by the companies which subsequently were aggregated into the Westmoreland Company, were adopted before any of the defendants, with one exception, (and he owning but a small acreage) became the owners or lessees of the tracks

of coal which they are now engaged in mining. At the time of these appropriations, and when the dam of the Mountain Company was built, in 1905, there was no injurious pollution of the stream; there then had been no commercial development of the coal. There were, however, a number of small country pits in operation, supplying coal in limited quantities to residents in the Indian Creek Valley, from the operation of which no injury had resulted to the waters of the stream.

Defendants operate mines on Indian Creek, and the drainage from them greatly contaminated with acid, flows into the stream, above the dam of the Mountain Company, and pollutes it. The court below on this subject said: "There is no denial in the evidence of the fact that the drainage of the mine water from the mines of the defendants into Indian Creek will injure the waters of the stream for both domestic and industrial uses. That was conceded throughout the trial of the case."

Plaintiffs allege that the draining of the mine water into the creek creates a nuisance. Defendants claim a right to so drain it and that the right is one of property, of which they cannot be deprived without due process of law and without compensation being first made or secured to them.

After the filing of bills in equity by the water companies and the railroad company to enjoin the flow of the mine water into the stream, a petition of more than 1,700 persons was presented to the Attorney General, requesting, in the public interest, his intervention in the proceedings, and permission was given to intervene in the name of the Commonwealth.

Defendants invoke the rule laid down in Pennsylvania Coal Co. v. Sanderson, 113 Pa. 126, as sustaining the right to drain their mines into the stream. Over that decision and the applicability to the facts in the pending cases, the controversy was waged before the chancellor and before us. He held the ruling there made determines these proceedings in defendants' favor. We are of opinion that the Sanderson case does not control the one in hand. The chancellor further concluded that the several water companies had not appropriated the waters of Indian Creek for public use; that the Mountain Company did not possess the power of eminent domain, and that neither the Dunbar Company nor the Westmoreland Company had exercised that power; that as there had not been a fully completed exercise of it, there had been no appropriation of the waters of the creek for public use, and that as the waters had not been legally so appropriated, there was no public interest which warranted the intervention of the commonwealth; invoking the rule of the Sanderson case he dismissed the bills.

Whether the Mountain Company has the power of eminent domain or whether the Dunbar Company and the Westmoreland Company possessing it, lawfully exercised it, is of no consequence. These cases do not lie within the narrow realm of legal formalities. This stream of pure water (one of the very few unpolluted ones in the section of the State where it is located) was impounded, primarily, for the purpose of furnishing uncontaminated water, to supply the motive power which is essential to the operation of one of the great railroad systems of the country. This primary purpose having been met, a large part of the surplus water, approximately 3,000,000 gallons per day, is being taken, by agreement between the Mountain Company and the Westmoreland Company, from the reservoir of the former and supplied by the latter to 75,000 people in thirteen municipal divisions of the Commonwealth for domestic uses. This being the fact, it is idle to say that the water is not being devoted to public use. It would never do to permit a screen of effete legal formalism to be raised to shut out the view of what actually exists in such a situation as here confronts us. It could not be averred, with wisdom and truth, that there is no public interest warranting the commonwealth's intervention, when the water supply of such a large number of persons is involved. Nor do we think it can properly be held that the use of the water by the railroad company is not a public one. The water is devoted by it to the furnishing of power to transport the public; without water uncontaminated by acid, the railroad could not be operated.

If authority were needed for the proposition that the water furnished to the Railroad Company is for a public use, it can be found in Bland v. Tipton Water Co., 222 Pa. 285, 289, where it is said: "In daily furnishing to the engines of the railroad company 350,000 gallons of water in that township, the water company is not exercising a mere right, but performing a duty, for the railroad company, in the operation of its road in said township is to be regarded as a part of the public therein."

The first error into which the court below seems to have fallen was in holding, that to constitute a public use of the water it must be taken under the right of eminent domain, and that there had been no exercise of this power by any of the plaintiff companies. The reason given for the conclusion that the Westmoreland Company and the Dunbar Company had not exercised the power of eminent domain, which each of them possesses, was because the resolutions which they adopted "were not followed by entry upon the ground and because no compensation ever was made or secured to defendants on their predecessors in title." In view of the agreement made by these two companies with the Mountain Company, which had the right under the act authorizing its incorporation to store and furnish the water, nothing further was required to be done by them. So far as the defendants are concerned, no compensation was due to them, because as upper riparian owners they were deprived of nothing by the appropriation of the water below them. The chancellor would also seem to have overlooked the rule, that settlement by an eminent domainer, with one whose property has been appropriated is equivalent to the full and complete exercise of the power of eminent domain: Boalsburg Water Co. v. State College Water Co., 240 Pa. 198; Hendler v. Lehigh Valley R. R. Co., 209 Pa. 256; 2 Lewis on Eminent Domain (3rd Ed. 1909) 845. One of plaintiff companies, the Westmoreland, and those affiliated with it, started proceedings to condemn the waters of the stream, their right to do so was challenged by the Mountain Company, whose interests in the creek were not only those acquired in pursuance of its charter, but those of a riparian owner as well. These proceedings culminated in a settlement and agreement for the taking of the water; this was the same as though they had been carried through to a finality. However, a corporation possessing the power of eminent domain acquires its rights, whether by purchase or condemnation, the rights acquired are the same; there is no magic in getting them under the power of eminent domain. Formal entry is not, as the court below seemed to think, requisite. The day for going through ceremonies in the law of property has passed; such symbolism as that involved in the handing over of a twig or clod of earth to indicate the passing of title is in the limbo of things well nigh forgotten. In the very recent case of Palmer Water Co. vs. Leighton Water Supply Co., 280 Pa. 492, we determined, that a water company actually located on a stream, and supplying water therefrom to the public, should be confirmed in its rights to so furnish it, as against the claim to the entire flow of the stream of another water company, subsequently created, even though the prior locating company had not strictly complied with the law in appropriating the water. The language of Mr. Justice Kephart in that case has strong pertinence to the ones in hand. (p. 498) "Here we have the Leighton Company, occupying the upper stream from which it supplied the public for some years before the Palmer Water Company existed, thrown off the stream because its hard board of directors failed to go through a form to appropriate the stream, though every other act of the company was consistent with the proper performance of its duties and obligations resting on it as a public servant." We there reiterated long ago used language of our predecessors in saying "the domestic uses of water are its natural and primary ones."

The lower court's ruling so far as the Mountain Company is concerned, if carried to its logical conclusion, would mean that that company can take the water only as a riparian owner can. The legislature, however, in endowing that company with power, indicated otherwise, and granted its prerogatives much beyond those of a riparian owner, but, even if it were

nothing more than a riparian owner, having acquired the rights of all the lower ones on the stream, it could divert the water and furnish it, as it is furnishing it, to the two other water companies, and defendants as upper riparian owners could not complain.

In their printed brief, counsel for appellees "concede without hesitation that if the Mountain Water Supply Company had the right to take the water from Indian Creek, it makes no difference how it carries or transports it, if it is devoted to a public use." The Mountain Company has the right to take the water from the creek under the express terms of its charter, and no one could gainsay this right except lower riparian owners. As it has acquired all such interests, its right to take the water cannot be successfully challenged. The water which it has the right to take is devoted to public use in two aspects, in that it goes to the public through the Westmoreland Company for domestic consumption and to the Pennsylvania Railroad Company for use by the latter in connection with the public service which it performs.

The court seems to have relied for its determination that there is no public use of the waters of Indian Creek, on Comth. v. Yost, 197 Pa. 171. If that case decided, under a state of facts at all comparable to those before us, what the chancellor conceived it to decide, it would not be followed by us now; but it does not determine that where a water company has acquired the right to the waters of a stream, by other than condemnation title, its only rights are those of a riparian proprietor and therefore private. That proceeding was a prosecution for committing a public nuisance in polluting a stream from which the York Water Company obtained water. There was no evidence that the water company had any right to divert the water or appropriate it for any purpose save as a riparian owner. It was held under this state of facts that the nuisance was not shown to be a public one, and hence a conviction could not be sustained. It was pointed out in the opinion that "If the public have a right to receive pure water through the agency of a corporation legally authorized to take it from a stream, he who pollutes it offends against the public." In the pending cases, the three water companies have the right to take the waters of the stream to a greater degree than would ordinary riparian owners, and the only deficiency in their rights which the trial court points out is the lack of the fully completed exercise of the power of eminent domain by the Westmoreland and Dunbar Companies (we are passing the question whether the Mountain Company possessed the power at all). If in Comth. v. Yost, it had appeared that the water company acquired the right to divert the water by purchase from all the lower riparian owners, it certainly would not have been held that its use of the water was not a public use and the nuisance not a public one.

Water companies incorporated since the Act of April 13, 1905, P. D. 152, have no power of eminent domain. If the lower court's view that water companies can be guaranteed the purity of their supply only by using eminent domain proceedings to acquire it be correct, then such companies as have been called into existence since the passage of that act are at the mercy of any mine which might be opened along their source of supply.

Having determined for the reasons to which we have referred that there was no public use of the water, the court below proceeded to apply to the controversy the rule of the Sanderson case. As we have shown, the conclusion reached that there was no public use of the water was fallacious. We have, therefore, a situation where the waters of a stream are devoted to public use. Does the Sanderson case apply under these circumstances? That litigation did not involve the rights of the public to the waters of streams in any sense. What was affected by the pollution of the stream was the private concern of that plaintiff. The case was determined on the balancing of the "necessities of a great public industry" and a "mere personal inconvenience." It was said: "The community does not complain on any grounds. The plaintiff's grievance is for a mere personal inconvenience and we are of opinion that mere private personal inconvenience arising in this case and under such circumstances must yield to the necessities of a

great public industry, which although in the hands of a private corporation subserves a great public interest. To encourage the developments of a great natural resource of a country, *trifling inconvenience* to *particular persons* must give way to the necessities of a great community." No language used in that opinion can be tortured into an implication that the waters of the commonwealth can be polluted by its mines, where the public is affected as it is here. It has always been under our law a nuisance to pollute a stream from which the public gets its supply of water; Barclay v. Comth., 25 Pa. 503: McCallum v. Germantown Water Co., 54 Pa. 40; Comth. v. Emmers. 221 Pa. 298.

Such an injury as was in the Sanderson case was held to be unredressable where the public is not involved. The rule there laid down is in consonance with that applied in many instances, where a condition is not held to be a nuisance which annoys or offends a single individual but which would be outlawed if the public were complaining.

So far as the use of the water is concerned it matters not how the public gets it, whether as customers of a water company or as riparian owners having the right to is domestic use. If there were a large number of riparian users on the stream in question, the public nuisance by pollution would be just the same. It is the use of the water by many people that makes its public use in applying the nuisance doctrine, not the fact of how the water is taken from the stream for their use, whether in the mains of a water company or by them in buckets.

The error of the trial judge in this case was the same as that pointed out in Comth. v. Russell, 172 Pa. 506, at page 520: "Is a city as helpless to protect the water supply on which it depends as Sanderson was held to be? Does a great municipality stand on the same ground, when the water supply for its multitudes of people is under consideration, as a single property owner must stand under Sanderson v. The Coal Company? * * * Notwithstanding the name of the commonwealth had been put on the record as a plaintiff at the instance of her attorney general, and notwithstanding the conclusive evidence of the destruction of the water supply for all domestic purposes, on which the borough of Butler had been dependent for many years, the case was disposed of on the narrow ground covered by the rule in Sanderson's case. The error of the learned judge lies in this treatment of the case." In Comth. v. Emmers, 221 Pa. 298, we lent our sanction to what was said by the Superior Court, "But whether this extreme exception (in the Sanderson case) to the general rule that a riparian owner has no right to pollute the waters of a stream could prevail against the right of the public is an entirely different question."

We now come to the consideration of the conclusion of the trial judge that the right to drain mine water into the stream is a property right. To reach this determination, he gave to the Sanderson case a much broader effect than it has ever before been given and overlooked how limited has been its application. It is somewhat difficult to understand why he badged the draining of the mine water into the stream as a "property right" in the defendants of which they cannot be deprived except upon payment being made to them. Nothing said in the Sanderson opinion warrants such conclusion, even from the standpoint of the private right involved and certainly not where public rights are at stake. No such term as a right of property was applied in that decision to the act of the mine owner in polluting the stream. He has taken out of the rule that his act was one of nuisance, by the exceptional situation there existing, and it was expressly stated, that the privilege accorded to him would not be sanctioned where the public is concerned. To say that there is no public concern in the use made of the waters of a stream which are supplied to 75,0000 individual consumers shocks the common understanding. In Sanderson's case, the court was most careful to state, "We do not say that a case may not arise in which a stream from such pollution may not become a nuisance and that the public interests as involved in the general health and well being of the community may not require the abatement of that nuisance. This is not such a case." The ones in hand are. The most that could be said of what was

accorded to the defendant in that much controverted case is, that is was a privilege. There could not be such a thing in the law as a property right to do a wrong, unless, it was founded in prescription, which presupposes a grant, and no prescription was set up in that case. Indeed "It is generally recognized that no right can be acquired by prescription to maintain a public nuisance. So it has been decided that there can be no prescriptive right to maintain an obstruction in the highway or to pollute a stream to the detriment of the public:" 2 Tiffany, Real Property (2nd Ed. 1920) 2031; Owens v. Lancaster, 182 Pa. 257, 262; 2 Lewis Eminent Domain (3rd Ed. 1909) 866 note; Comth. v. Sisson, 189 Mass. 247, 75 N. E. 619.

Dwight Printing Co. v. City of Boston, 122 Mass. 583, completely answers the claim set up by appellees of a right to pollute the stream in view of the interest of the public in it. In that case, the City of Boston had appropriated the waters of a river as part of its water supply. A petition was filed by an upper riparian owner praying for an assessment of his damages upon the ground, among others, that the appropriation interfered with the petitioners' use of the water in bleaching and dyeing cloths. The Supreme Judicial Court of Massachusetts, in disposing of the plantiff's contentions, said (p. 587-589); "The riparian proprietors higher up still retain all their common law rights in the river, so far as they are not inconsistent with the use defined in the statute. They certainly are not prohibited from drawing water from the river for domestic purposes, or from watering cattle in it or from cutting ice. * * * Another claim, put forward by the petitioner, is that the use which it proposes to make of the water of the river in bleaching and dyeing woolen and cotton cloths must befoul the water and render it unfit for drinking purposes, and that the statute in question deprives it of that right. But it is agreed that the petitioner has acquired no such right by any grant or prescription, and it is well settled that, as a riparian proprietor merely it has no such right. An injury to the purity or quality of the water to the detriment of other riparian owners, constitutes in legal effect a wrong and invasion of private right, in like manner as a permanent obstruction or diversion of the water." The title acquired by defendants, whether by grant or demise, gave them no property rights in the waters of the stream save those which pertained to riparian ownership; obviously this did not include the right to pollute the stream: (Howell v. M'Coy, 3 Rawle 256; Comth. v. Emmers, 221 Pa. 298, 304). It could not be said that a land owner on a water course whose rights in the stream are only those of a riparian proprietor (and none other are shown in defendants), would have them enlarged to one of a property in the use of the waters by the discovery or development of coal on his lands.

Our conclusion is that defendants have no right of any kind to drain their mine waters into the stream considering the public use which is made of its waters and that their so doing constitutes a nuisance which must be restrained.

We recognize, however, as evidently the court below also did, that the public has an indirect interest in the business of defendants, and hence, applying the principle that he who seeks equity must do equity, the decrees to be entered should require plaintiffs (other than the Commonwealth), so far as this can reasonably and legally be done, to afford defendants an opportunity to transport and dispose of the mine water of their respective mines in such a way as shall minimize the expense of so doing; and the decrees, after their entry, should be enforced in the same equitable spirit. In fairness to plaintiffs it should be stated that their counsel, in oral argument at the bar of the court, expressed the willingness of their clients to thus cooperate with defendants.

The decrees of the court below dismissing plaintiffs' several bills of complaint are reversed, the bills are reinstated, and, it is directed that the court below shall enter decrees, enjoining and restraining defendants, and each of them, from discharging, pumping or causing or permitting to flow or to be discharged, any drainage of mine water from their mines, and from the mines of each of them, into the waters of Indian Creek, or its tribu-

taries, above the dam of the Mountain Water Supply Company, after the expiration of six months from the date of the entry of the decrees. It is further directed that defendants shall pay the costs.

(SUPREME COURT OF WISCONSIN, JUNE 23, 1924.)

Mitchell Realty Co. et al. v. City of West Allis.

1. Municipal corporations, No. 838—Pollution of stream by sewage subject to abatement as nuisance.

City polluting stream and creating nuisance by construction of sewer system may not avoid liability because it has established a recognized system or was not negligent in adoption of a proper plant, but is liable for damages and subject to injunctive relief, having as its aim abatement of nuisance.

2. Municipal corporations, No. 837—Collection of surface water in sewers and precipitation into stream causing overflow actionable.

City held liable for collection in sewers surface and storm waters and precipitation of same into stream in such manner as to cause an overflow and deposit on land.

* * * * * *

(1) The defendant city therefore cannot hide behind or protect itself by reason of the fact that it has created and maintains a recognized sewage disposal plant, or that it was not negligent in its adoption of a proper plant. In creating a nuisance as is clearly established in the instant case beyond controversy, it must respond in damages, and it is subject to the injunctive relief prayed for by the plaintiff realty company, having as its aim the abatement of the nuisance.

* * * * * *

(6) *It is our view, therefore, that the action as originally begun was maintainable, and that the order of the lower court in striking out the allegations as to damages with respect to the private corporations charged was erroneous. Had the action proceeded, the plaintiffs could have obtained their equitable remedy for the abatement of the nuisance, and, upon the determination by the court of the proportionate share of the damage caused by each of the defendants, were entitled to judgment for such amounts, thus disposing of the entire litigation in one action.*

* * * * * *

(11) Plaintiffs' counsel has filed a cross-appeal, and he contends in his brief that the damages awarded by the trial court are inadequate, and that the court evidently overlooked the undisputed evidence in the case. It appears that in computing the damages only 45 acres of the land of plaintiff realty company was taken into consideration, and that the undisputed evidence in the case shows that the actual acreage sustaining damages amounts to 68 acres, and, furthermore, the damages to the property of the realty company were limited at $43.75 per acre. The undisputed evidence shows that the minimum damages computed by experts on the entire acreage amounted to $50.00 per acre. With respect to 23 acres no damages whatever were assessed, and the evidence is undisputed that such 23 acres were damaged precisely as were the 45 acres. Furthermore, nothing was allowed whatever for the rehabilitation of these 23 acres, and the testimony shows that it will require a minimum expense of $15.00 per acre for the rehabilitation of such 23 acres. Assuming, therefore, that the plaintiffs are entitled to recovery herein, the damages must be computed in accordance with the undisputed testimony, and under such testimony such damages should have been materially increased over and above the amount actually allowed. The action, however, having been tried upon the erroneous theory as indicated by the opinion, the judgment of the lower court must be reversed.

The use of pure waters of our streams is a heritage of the people living along their banks, if, indeed, it is not the privilege of the public generally to use and enjoy these waters as nature provided them. As the country settles, these streams are polluted in many ways. The cultivation of land of itself brings large quantities of soil, weeds, obnoxious seeds and other debris to the stream, which damage and inconvenience

the residents below. The presence of live stock adds another form of pollution. Trade wastes coming from such industries as oil wells, canning factories, gas works and many other industries, pollute the streams so as to make them dangerous to fish life and unsafe for drinking purposes for live stock. Sanitary sewage from cities and villages, and even from private residences, also add dangerous forms of pollution, which in addition to destroying fish life and endangering the lives of life stock, may spread disease. All these conditions resulting from settlement, call for steady and a large expenditure by public and private funds in an effort to purify our waters and keep them in a condition where they may serve the people most for pleasure and profit.

CHESTER PENITENTIARY WATER SUPPLY.

In the construction of the new water supply plant for the Chester Prison, Mr. Sjoblom has been detailed by the Division of Waterways to assist the Department of Welfare in an engineering capacity in designing an constructing this plant. The work on the installation of the new water supply and new outfall sewer for the Southern Illinois Penitentiary at Menard is now nearing completion. This work was supervised by the Division of Waterways at the request of the Department of Welfare.

Chester Prison has for years been compelled to depend on a small spring for water for drinking and culinary purposes. The supply at times becomes very low, especially during the hot weather, and at best is very inadequate. It is also a potential source of disease as the water must all be handled in buckets by prisoners.

The improvements include a mechanical filtration plant with a capacity of 600,000 gallons per day, a large clear well and a pipe line leading from a new low lift pump station constructed one mile down river. The new low lift pumping station was built in order to do away with the intake troubles that are had at the present pumping station where sand bars have been giving no end of trouble. In addition to the waterworks, a large sewer was laid from the prison to a point below the new intake and below the Chester intake.

The work is practically completed, the filter units being in readines to operate as soon as a new power line to carry power from the prison power house to the low lift pumping station is completed.

The work has all been done by prison labor, which at best is inefficient and poor unless supervised very carefully. Naturally the work has progressed very slowly. However, by the use of convict labor on all the work the improvement, which includes more than originally called for, was done at considerably less than the sum appropriated for this work, which in turn was far less than would have been necessary had the work been done by contract. The work here indicates that considerable saving can be made to the State by the cooperation between its different departments.

HYDRAULIC ENGINEERING SERVICE.

The general question of the hydraulics of our streams and the problems of encroachment, pollution, and other applied suggestions require the constant services of Mr. Murray Blanchard, Hydraulic Engineer,

Mr. Potter, Drainage Engineer, Mr. H. C. Alexander, Engineer in charge of Permits, and Mr. Sjoblom, Sanitary Engineer.

These men are all qualified to conduct the work entrusted to them. The varied nature of these duties, outlined in a measure by the summary of work done by Mr. Potter and Mr. Blanchard, which reports follow:

SUMMARY OF WORK DONE BY W. G. POTTER.

For Year Ending June 30th, 1925.

SEWERAGE PERMIT REPORTS.

Schiller Park—Permit granted.
Matteson—Permit granted.
Steger—Permit granted.
Lansing—Permit granted.
Pittsfield—Permit granted.

DAMS.

Carthage—Permit granted.
Carmi—Permit refused and application withdrawn.
McHenry—Survey of flooded property.

SEWAGE POLLUTION COMPLAINTS INVESTIGATED.

DesPlaines River above DesPlaines.
Effingham city sewage.

MANUFACTURING WASTES POLLUTION INVESTIGATED.

Wedron Silica Co.—Sand washed into Fox River.
Oil pollution from wells along Wabash tributaries.
Coal mine acid wastes.
Tiskilwa Gas Co.—Oil and tar wastes.
Waterloo Oil Fields—Oil and salt water.
Waterloo Milk Co.—Milk wastes.
Pevely Dairy Co.—Milk wastes at Effingham.
Benjamin Electric Co.—Acid wastes.

DRAINAGE DISTRICT PERMIT INVESTIGATIONS.

Lincoln-Lansing Drainage District.
Chataqua D. & S. District complaint.
Weller Creek Drainage District.

ENCROACHMENTS.

Vermillion River at Pontiac by Pub. Serv. Co. of N. I.
Rock River—Dix on Distilled Water Ice Co.
Rock River—Vallini at Rockford.
Fox River—Western United Gas & Electric Co. at Aurora.
First Addition to Wheaton Park Manor—Insufficient waterways.

SHORE LIMITATION LINES ESTABLISHED.

Rock River at Rockford—Vallini property.
Rock River at Rockford Country Club.
Rock River at Rockford—H. F. Steffan.
Fox River at Aurora—W. U. Gas & Electric Co.
Fox River at Aurora—Esser property.

MISCELLANEOUS INVESTIGATIONS.

W. United Gas & Electric—Pipe in Fox River at Aurora.
Naples Levee—Preparation for contract work.
Pecatonica River—Survey and report.
Van Nortwich application to fill part of race at Batavia.

Grassy Creek bridge for S. I. & K. Ry.
Ice gorges in Kankakee River.
Ice gorges in Rock River.

BRIDGE PERMIT INVESTAGATIONS FOR DIVISION OF HIGHWAYS.

Macoupin Creek at Kane.
Kishwaukee River near Morengo.
DesPlaines River—Winnetka—Palatine Road.
Saline River near Harrisburg.
Vermillion River at Pontiac.
Spoon River near Duncan Mills.
Plum River, Carroll County.
Kishwaukee River near Kirkland.
Salt Creek near Lincoln.
Otter Creek, Fulton County.
Spring Creek near Spring Valley.
Dupage River at Channahan.
Little Calumet River, Burnham Avenue.
Vermilion River near Danville.
Big Muddy River at Murphysboro.

W. G. POTTER, *Engineer.*

July 27, 1925.

From Murray Blanchard, Hydraulic Engineer,
To M. G. Barnes, Chief Engineer.
Subject: Annual Report of Hydraulic Engineer.

EXHIBITS.

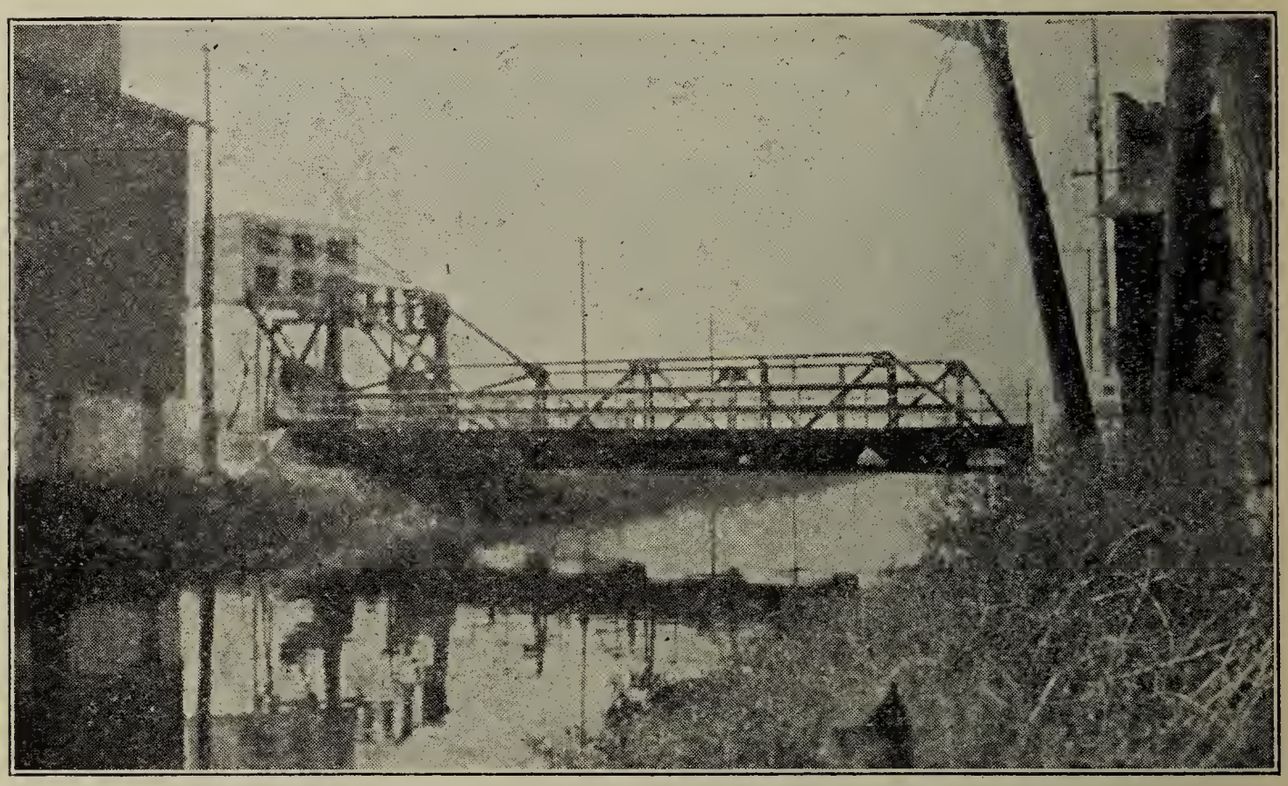
The entire time for two months in the fall of 1924 was devoted to demonstrations with exhibits of this Department at several fairs in the northern and central part of this State. Short talks were made in connection with the operation of a model lock. The purpose was to inform the people of the State as to what the Illinois Waterway is, how it will be operated and how it will benefit the people of the entire State and particularly those having available, the State's navigable waters.

ILLINOIS AND MICHIGAN CANAL.

Various investigations were made pertaining to the Illinois and Michigan Canal. Some of those were in reference to contracts for the sale of surplus canal waters for commercial purposes such as supplying boiler feed water, the harvesting of ice, etc. Data were obtained, prepared and used in damage cases before the court of claims in Springfield. Estimates were made and a report submitted on the cost of construction of new culverts to replace the present structures at Gum Creek and Matchtown both in the city of Marseilles. Appropriations have been made for both of these projects.

INVESTIGATIONS.

Among the miscellaneous investigations was the condition of the Marine Railway at the Spring Lake Drainage and Levee District some ten miles below Pekin. Here a steel carriage mounted on tracks and turntables with power house and motor equipment was installed by the commissioners of the district in 1914 in compliance with the terms of an agreement between them and the Attorney General of the State. This Marine Railway was required to provide a means to make possible navigation for grain barges on a small stream in the bottom lands after the construction of a levee across the stream enclosing the stretch on which grain elevators were located. However, as soon as the levee was completed elevators were erected along the levee so that it was no longer necessary for barges to enter the district, consequently the Marine Railway was never used and it is not likely that it ever will be. Under the circumstances the Commissioners have taken no interest in maintaining the structures. Machinery



Bridge over I. and M. Canal at Seneca. Built by Division of Waterways in 1925.

Bridge over I. and M. Canal at LaSalle. Built by Division of Waterways in 1925.

has been stolen and the carriage on the turntable, swung into alignment with a road, is now used as a highway bridge.

Other investigations have been made in connection with bridges, culverts and dams to determine and pass on the waterway openings, spillways and the like.

Numerous hydraulic problems relating to the Illinois Waterway and streams throughout the State were encountered and solved.

Studies were made of channel widths and other conditions for various flows and depth of water from Lockport to Grafton.

WATER POWER.

Studies were made to determine the required withdrawals from Lake Michigan in connection with various channel conditions at Illinois Waterway Lock sites and the effect on the Water Power Development at these stations.

Data were compiled for application to the Federal Government for a Permanent Water Permit for the Illinois Waterway and data were compiled in connection with the State-Breit Water Power Project at Dayton.

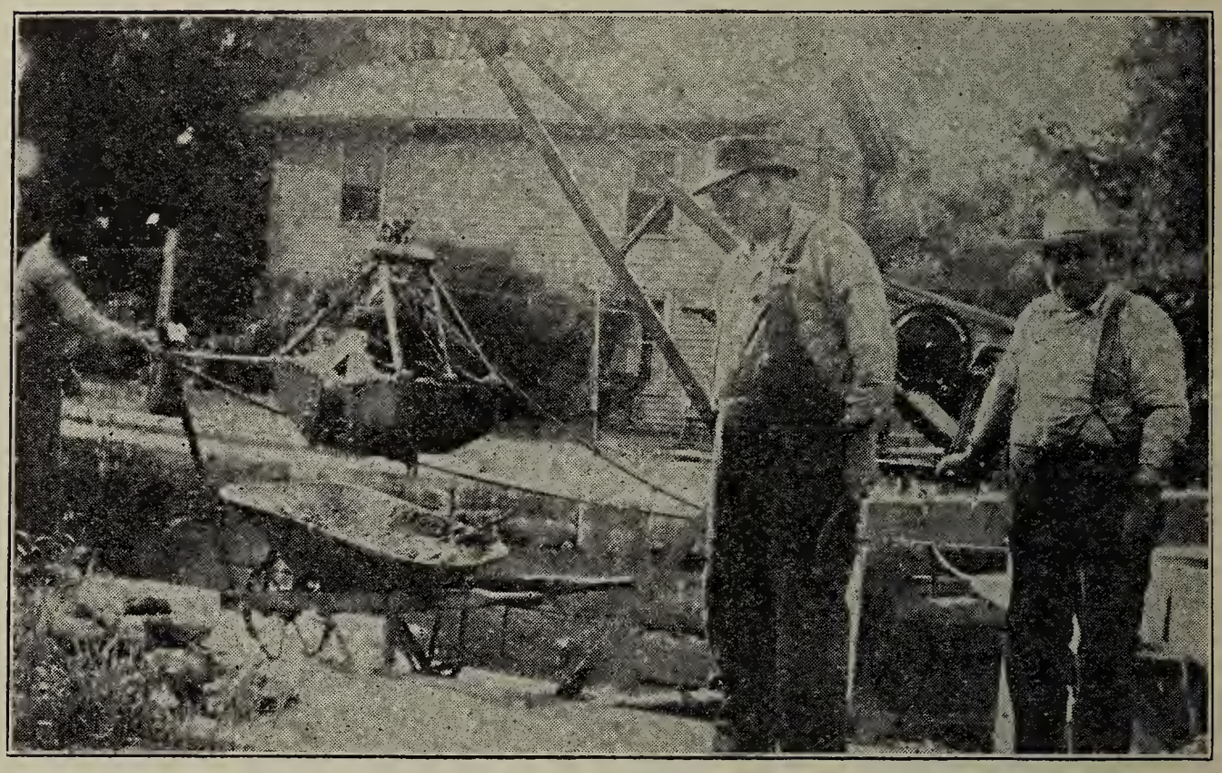
Yours truly,

DIVISION OF WATERWAYS.
(Signed) MURRAY BLANCHARD.
Murray Blanchard, Hydraulic Engineer.

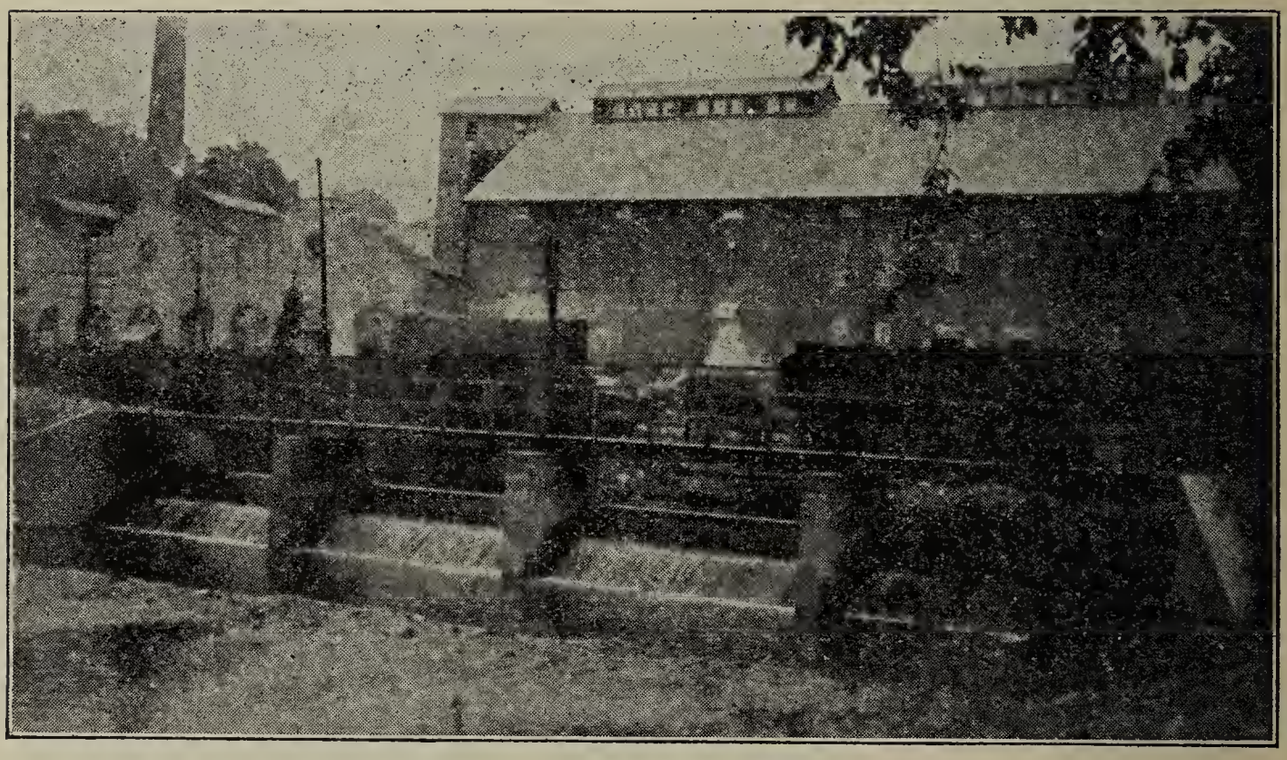
ILLINOIS AND MICHIGAN CANAL.

As mentioned in note in our Seventh Annual Report, a very unusual rainfall occurred in the first week of August, 1924, which resulted in serious damage to the Canal banks and put the Canal out of commission for the balance of the fiscal year. This stopped all navigation over the only connecting waterway between Chicago and the Lower Illinois River. This prevented any collection of tolls or other income from navigation (small though it has been in recent years) to aid in the up-keep of the Canal. This flood also has cost a large sum of money in repairing Canal banks and structures, which has reduced the amount of funds available for this purpose. Some of the other items of income have also been reduced. For example, the income from the Quaker Oats plant in Joliet, amounting to $2,560.00, has been eliminated for the reason that this Company has ceased to use power from the water of the I. & M. Canal. Other leases and revenues have expired, which amount to about $1,600.00. In other words, expenditures have been unusually high because of the flood above referred to. In repairing the Canal banks Mr. Brennan, the Contractor, was paid $4,793.40 on his contract, and the Joliet Construction Company was paid $8,995.00 for construction of Pecumsaugen Creek spillway. Moreover the maintenance crew has been constantly employed on repair work in addition to the usual expenditures for maintenance. The work being done on the Canal during this fiscal year has been in the nature of permanent construction, the benefits of which will show in future maintenance expenditures. For example, a new derrick and bucket for cleaning locks and other structures has been purchased and will be serviceable for many years, and its service has lessened very materially the cost of such maintenance work.

Three new lock gates were installed at Lock No. 7.



Cleaning debris from I. and M. Canal.



Pecumsaugen Creek spillway, I. and M. Canal. Built by Division of Waterways in 1925.

New flat boat, 18′ x 6′ x 18″, has been constructed and put in use. A new barge 50′ long has also been constructed and is in use in repair and maintenance work. The new spillway at Pecumsaugen Creek is a permanent construction and of modern design, and will avoid troublesome and expensive attention in maintaining the water level at that pool.

The old steamer "Aeolius" has been condemned by the United States inspectors and the boat has been junked and a smaller and more adequate tow boat installed. The Canal has owned a steel launch known as "Joe Junior" but which was not equipped with power. A new and very efficient gasoline motor has been purchased and placed in this steel hull and the boat equipped to handle all towing and other work in connection with the repairs and maintenance. This has resulted in a saving of $250.00 a month for licensed engineer and pilot, and $50.00 to $60.00 a month in operating expenses and repairs due to the use of gasoline instead of coal for this purpose. Moreover as the laborers employed on general repair work operate this boat, their services may be used for other purposes when the boat is not in commission.

It is proposed during the next fiscal year to remodel the State dredge so that it may be used and towed from pool to pool without lowering the mast to pass under bridges. This will save much time and expense for such purposes and permit of quicker action in repairing in emergency cases. These permanent repairs and improvements to the equipment will result in cheaper operation in the future.

However, in view of the adverse conditions under which the Canal has been operated this year, the balance in the fund at the end of the year was only approximately $5,000 less than at the beginning of the fiscal year. Moreover in the repairs to the Canal due to the flood the Chicago, Rock Island & Pacific Railroad will pay to the State $3,750 as a benefit to the Railroad Company from the construction of the Pecumsaugen brick spillway, and the Chicago, Ottawa & Peoria Railroad Company will also pay to the State the sum $1,000 as a benefit from such construction. When these two sums have been credited to the Canal fund it would show that the balance is very close to the balance at the beginning of the year. (Note: At the writing of this report the Railroads have paid into the Canal fund the sums mentioned.)

Revenues from some of the other Canal rentals have been increased, and especially from rentals of the 90-foot strip. Rentals from this item now amount to $16,528.42 per year.

It is expected that the repair work due to the flood of the first week in August, 1924, will be completed by September 1st and Canal again put in commission. It is recommended that the Canal be kept in commission as long as funds permit, and that construction and repair work be done in a permanent manner so that the Canal may be used for local business and also for the transfer of pleasure vessels and other craft of light draft so as to relieve the Illinois Waterway when it is completed.

The following is a statement of receipts, expenditures and statistics for the fiscal year, July 1, 1924 to June 30, 1925.

SUMMARY SPECIAL CANAL FUND AND ACTIVITY REPORT.

July 1, 1924 to June 30, 1925.

Balance on hand July 1, 1924		$49,270.34
Expenditures July 1, 1924 to June 30, 1925	$40,633.79	
Receipts July 1, 1924 to June 30, 1925	35,577.05	
Expenditures over receipts	$ 5,056.74	
		5,056.74
Balance on hand July 1, 1925		$44,213.60

ILLINOIS AND MICHIGAN CANAL EXPENDITURES.

July 1, 1924 to June 30, 1925.

Salary lock tenders and officers	$10,320.00
Labor payrolls	11,878.55
Repairs	14,261.10
Maintenance and operation	3,615.44
Equipment	558.70
Total expenditures	$40,633.79

RECEIPTS.

July 1, 1924 to June 30, 1925.

90-foot strip, lots and bridge rentals	$16,528.42
Water power rentals	11,501.22
Boat house rentals and levee licenses	57.50
Water pipe rentals and miscellaneous	6,260.81
Ice leases	795.00
Certified copies	7.50
Tolls and lockages	326.60
Quit claim deed	100.00
Total	$35,577.05

EXPENDITURES.

July 1, 1924 to June 30, 1925.

From canal appropriation	$40,633.79
From river appropriation	17,676.54
From bridge at Seneca appropriation	13,474.43
From Bridge at LaSalle appropriation	9,064.36

Number of boats running, clearances issued, tolls and lockage collected, and tons transported on the Illinois and Michigan Canal and through Henry and Copperas Creek Locks for period July 1, 1924 to June 30, 1925:

	Copperas Creek.	Henry.	Joliet.	Ottawa.	Total.
Tolls and lockages	$91 79	$122 68	$77 06	$35 07	$326 60
Boats cleared	20	40	53	11	132
Tons transported	4,835	8,074	121	57	13,067

Statement of the principal articles transported upon the Illinois River, cleared at Collector's office at Locks, at Henry and Copperas Creek, for the year ending June 30, 1925:

Articles.	Measure.	Copperas Creek.	Henry.	Total.
Corn	Bushels	42,800	74,500	117,300
Wheat	Bushels	21,891	3,690	25,581
Rye	Bushels	500	1,000	1,500
Oats	Bushels		36,304	36,304

PUBLICATIONS FOR DISTRIBUTION BY THE DIVISION OF WATERWAYS.

Issued by the Rivers and Lakes Commission of Illinois 1911-1916.

* * *

BULLETINS.

No. 1 The Conservation of Water Power in the DesPlaines and Illinois Rivers and the Improvement of these Rivers for Navigation—1911.

No. 2 Prospectus of a project for a Deep Waterway and conservation of a natural resource of the State of Illinois, prepared by Lyman E. Cooley —1911.

No. 3 Uses of the Great Lakes—1912.

No. 4* Land Drainage in Illinois, by Robert Isham Randolph—1913.

No. 5 A compilation of money spent by the Government on various Harbors, Rivers and Canals, and the riparian property holders benefited—1912.

No. 6 Argument on behalf of the State of Ilinois supporting the prayer of the Sanitary District of Chicago for a permit to take 10,000 cubic feet of water per second from Lake Michigan, by Isham Randolph—1912.

No. 7* The 1912 Flood on the Lower Mississippi, by A. L. Dabney, Consulting Engineer, and "The 1912 Flood in the Ohio and Mississippi Rivers," by H. C. Frankenfeld—1912.

No. 8 Proceedings of the organization meeting of the Association of the Mississippi Valley States for river control—1912.

No. 9. The Illinois Water Power Waterway—1912.

No. 10 The Illinois Waterway—A Guide for Navigators from Lake Michigan to the Mississippi River via the Chicago Sanitary and Ship Canal, the Illinois and Michigan Canal and the Illinois River. Also an Alternate Route via the Illinois and Mississippi Canal—1916. (Fourth edition 1921.)

No. 11* European Harbor Development, by Robert R. McCormick—1912.

No. 12* Common Sense applied to the Inland Waterway Problem, by Robert R. McCormick—1912.

No. 13 The Illinois Waterway, A Review, by Isham Randolph—1912.

No. 14 Water Resources of Illinois—A cooperative report prepared by Rivers and Lakes Commission and A. H. Horton, District Engineer of the United States Geological Survey—1914.

No. 15* The Illinois Waterway—A Project for a waterway of eight feet minimum depth between Lockport and Utica and available for immediate construction—1914.

No. 16 Stream Pollution and Sewage Disposal in Illinois with reference to Public Policy and Legislation, by LeRoy K. Sherman—1915.

No. 17* Report of Survey and investigation of La Moine River, with Reference to Flood Control and Navigation.

No. 18* Flood Control for Pecatonica River—1916.

No. 19* Project for a Navigable Waterway from Southern Illinois Coal Fields to Mississippi River—1917.

No. 20* The Illinois Waterway Report with plans and estimates of cost for a deep waterway from Lockport to Utica by way of the DesPlaines and Illinois Rivers, Internal Improvement Commission—1909.

* On file in office of Division of Waterways. Supply for distribution exhausted.

No. 21* Surface Water Supply of Illinois, Internal Improvement Commission—1908—1910.

No. 22 Report and (Plans*) for reclamation of lands subject to overflow in the Kaskaskia River Valley, Illinois—1910—1911. Postage 16 cents.

No. 23 Report upon the prevention of overflow of the Little Wabash and Skillet Fork Rivers—1911. Postage 16 cents.

No. 24 The Illinois River and its Bottom Lands, by Alvord and Burdick—1915* 2nd Edition 1919.

* Map and Profile of Fox River—1915.

Annual reports of Rivers and Lakes Commmission 1912*—1913—1914—1915*—1916*

ISSUED BY THE

DIVISION OF WATERWAYS

SUCCESSOR TO RIVERS AND LAKES COMMISSION.

* First annual report—1917-18.

Second, Third, Fourth, Fifth, Sixth, Seventh and Eighth Annual Reports 1918-25.

Saline River report 1920 (See Third Annual Report).

No. 25 Big Muddy River Report 1922—(Also in Fifth annual report).

No. 25½ Floods in Illinois in 1922—causes, results and remedies (Also in Fifth Annual Report.)

Pecatonica River report—1924 (See Seventh Annual Report).

Report of the Interstate Harbor Commission of Illinois and Indiana on Harbor and Terminal Development at the State line between Illinois and Indiana and in Chicago Industrial District—1922.

Inland Waterways and Transportation cost by M. G. Barnes, 1920.

FOR ANY OF THE FOREGOING PUBLICATIONS, ADDRESS SUPERINTENDENT OF WATERWAYS, 950 TRANSPORTATION BUILDING, CHICAGO, ILL.

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* On file in office of Division of Waterways. Supply for distribution exhausted.

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NINTH ANNUAL REPORT

OF

DIVISION OF WATERWAYS

1510 - 220 SOUTH STATE ST.

OF

THE DEPARTMENT OF PURCHASES AND CONSTRUCTION

July 1, 1925

TO

June 30, 1926

LESLIE SMALL, Director
WILLIAM F. MULVIHILL, Superintendent of Waterways
M. G. BARNES, Chief Engineer

[Reprinted from the Ninth Administrative Report. Printed by authority of the State of Illinois.]

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1925

NINTH ANNUAL REPORT

OF

DIVISION OF WATERWAYS

OF

THE DEPARTMENT OF PURCHASES AND CONSTRUCTION

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TO

June 30, 1926

NATURAL HISTORY BUILDING
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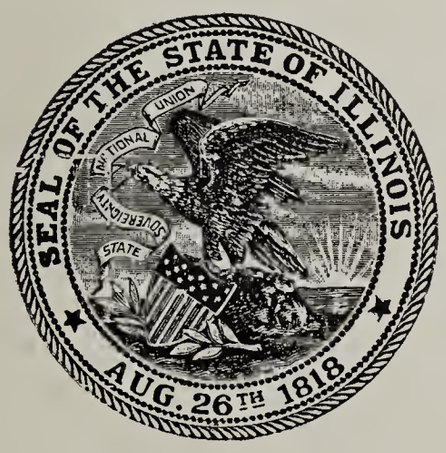

LESLIE SMALL, Director
WILLIAM F. MULVIHILL, Superintendent of Waterways
M. G. BARNES, Chief Engineer

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SPRINGFIELD, ILLINOIS
1927

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WATERWAYS.

Wm. F. Mulvihill, *Superintendent.*

This report, being the Ninth Annual Report of the Division of Waterways, covers in outline the work of the division from July 1, 1925 to June 30, 1926.

I was appointed Superintendent of Waterways, September 1, 1925, succeeding the late Wm. L. Sackett, who died December 16, 1924. The work of the division was in charge of the Chief Engineer, Mr. M. G. Barnes, from the time of Mr. Sackett's death until the date of my appointment.

Under an amendment to the Administrative Code, effective July 1, 1925, the Division of Waterways was transferred from the Department of Public Works and Buildings and became a part of the newly created Department of Purchases and Construction.

EXTENT OF JURISDICTION OF THE DIVISION OF WATERWAYS.

The law confers upon the Division of Waterways, the powers, duties and jurisdiction formerly exercised by the Rivers and Lakes Commission with especial reference to its jurisdiction over all rivers and lakes of the State of Illinois, to prevent pollution thereof or encroachments thereon; the powers and duties of the Illinois Waterway Commission with reference to the construction, operation and maintenance of the Illinois Waterway, and for the development and utilization of the water power thereof; and also the powers of the Illinois and Michigan Canal Commissioners for the control and management of the Illinois and Michigan Canal, the maintenance of the navigalibity thereof and the sale and lease of canal lands and property.

JOLIET APPROVES CONSTRUCTION PLANS.

At the beginning of this fiscal year a somewhat complicated situation existed at Joliet growing out of the legal requirement that the plans and specifications for the Brandon Road lock and dam just south of the city limits of Joliet must be approved by the Mayor and City Council of that City. These structures will raise the water at the City limits about 30 feet, requiring the building of retaining walls on each side of the Waterway throughout the city. Plans for these retaining walls were submitted to the city April 16, 1923, but were not approved.

FORMER PLANS WERE NOT APPROVED.

The city appointed an advisory board of five engineers to study the plans. After extended negotiations between the State and this board, the Joliet City Council, by resolution, on April 13, 1925, objected to the plans submitted on the ground (1) that the approaches at the east end of the bridges called for grades not greater than 7 per cent, and (2) that no specifications were submitted with these plans.

The State thereafter on May 18, 1925, withdrew its plans from further consideration and negotiations regarding the approval of modified plans were undertaken.

On September 25, 1925, revised plans were submitted, whereby (1) the width of Cass Street and Jackson Street bridges were changed to conform to existing widths and (2) the bridge approaches at the east end were changed from a maximum of 7 per cent to 5 per cent.

STIPULATION AS TO SEWAGE DISPOSAL.

The letter transmitting the revised plans contained a stipulation, intended to prevent any future misunderstanding as to the respective duties and obligations of the State and City regarding Joliet sewage disposal.

A certified copy of the minutes of the Joliet City Council meeting held October 5, 1925, showing approval of the plans and specifications and of the letter containing the stipulation referred to, is made a part of this report.

JOLIET COUNCIL PROCEEDINGS.

"Regular meeting of the Council of the City of Joliet held Monday, October 5, A. D., 1925, at 2:00 o'clock p. m.

Present: Mayor George F. Sehring and Commissioners Bothwick, Cleary, Hennessy and Strohm.

Absent: None.

JOLIET ENGINEER BOARD REPORT.

"The plans covering Contract No. 6 of the Illinois Deep Waterway, per date of August 24, 1925, for approval by the Mayor and City Council of Joliet, Illinois, together with the report of the Board of Engineers which is as follows:

August 25, 1925.

To the Hon. Mayor and Council,
City of Joliet.
Gentlemen:

We, the undersigned Board of Engineers appointed to examine the plans of the proposed Waterway through the City of Joliet as submitted by the State of Illinois, beg leave to report as follows:

The plans as submitted are for work embraced in Contract No. 6, and are not intended to cover all of the work of the entire project. No specifications accompanying said plans and it is understood that they will be submitted later.

The plans as submitted for Contract No. 6 meet with the approval of the undersigned.

Respectfully submitted,

(Signed) A. S. Calkins,
Public (City) Engineer.

(Signed) Arthur Montzheimer,
Chief Engineer, E. J. & E. R.R.

(Signed) Hubert A. Stevens,
Consulting Engineer.

were presented.

Commissioner Bothwick moved that said plans and report be received and placed on file.

Motion carried by the following vote:
Ayes: Sehring, Bothwick, Cleary, Hennessy and Strohm.
Nays: None."

TEXT OF LETTER FROM DIRECTOR.

The following communication was presented and read:

"September 25, 1925.

To the City Clerk,
City of Joliet,
Joliet, Illinois.
Dear Sir:

As required by the Illinois Waterway Act of 1919, I am handing you herewith specifications and revised plans covering contract number six (6) of the Illinois Waterway for approval by the Mayor and City Council of the City of Joliet.

The plans herewith submitted cover the same work which the City Council, by resolution, objected to April 13, 1925, on the ground (1) that the approaches at the east end of the bridges called for grades not greater than seven per cent (7%), and (2) that no specifications were submitted with these plans.

The former plans were, on May 18, 1925, withdrawn. The plans now submitted, together with specifications, are intended to meet the objections raised by the city. In all matters the plans are essentially the same as originally presented, except:

First: The width of Cass Street and Jackson Street bridges has been changed to conform to their present widths.

Second: The approaches to the bridges at the east end have been changed from a maximum of seven per cent (7%) to a maximum of five per cent (5%).

These plans are submitted with the stipulation that approval of the same by the City of Joliet and the construction by the State of Illinois of the works proposed, including the intercepting sewers provided for, shall not be construed as in any way relieving the City of Joliet from the necessity of providing proper sewage treatment or disposal plants, as is now or may hereafter be required by law, nor to obligate the State in any way to care for sewage of the City of Joliet, otherwise than as provided in the plans and specifications herewith submitted.

Trusting that the plans and specifications herewith submitted will receive early consideration and approval by the Mayor and City Council, so that contracts may be let and this important piece of work started at an early date, I am

Yours very truly,
(Signed) LESLIE SMALL, *Director.*

Approved as to engineering:
(Signed) M. G. BARNES,
Chief Engineer.

Recommended by:
(Signed) WM. F. MULVIHILL,
Superintendent of Waterways."

PLANS AND SPECIFICATIONS APPROVED.

"Commissioner Bothwick moved that said communication be received and made a matter of record and the plans submitted August 2, 1925, together with plans and specifications submitted October 5, 1925, be received, filed and approved by the Council.

Motion carried by the following vote:

Ayes: Sehring, Bothwick, Cleary, Hennessy and Strohm.
Nays: None.

* * *

Commissioner Bothwick moved that the Council adjourn.
Motion carried by the following vote:
Ayes: Sehring, Bothwick, Cleary, Hennessy and Strohm.
Nays: None.

(Signed) WM. C. STROHM,
Commissioner of Accounts and Finances.
(Signed) PHIL PECK,
City Clerk."

CERTIFICATE OF AUTHENTICITY.

"STATE OF ILLINOIS }
Will County } ss.

I, William C. Strohm, do hereby certify that I am the Commissioner of Accounts and Finances of the City of Joliet, duly elected, qualified and now performing the duties of such office, under the laws of the State of Illinois and the ordinances of the City of Joliet, and I, Phil Peck, do also certify that I am City Clerk of the City of Joliet, duly appointed, qualified and now performing the duties of such office, under the laws of the State of Illinois and the ordinances of the City of Joliet; that we are the official keepers and legal custodians of the records, papers, entries, ordinances, resolutions and files of the Council of the City of Joliet, in the County of Will and State of Illinois, and

We Do Further Certify, That the foregoing annexed is a true and correct copy of the journal of the proceedings of the Council of the City of Joliet, at its regular meeting held Monday, October 5th, A. D. 1925, at 2:00 p. m., in so far as the said proceedings relate to the following:

(1) Presentation and placing on file of the Plans covering Contract No. six (6) of the Illinois Deep Waterway under date of August 24, A. D. 1925, and

(2) Report of the Board of Engineers on said Plans under date of August 25, A. D. 1925;

(3) Letter of Leslie Small, Director of the Department of Purchases and Construction, Division of Waterways, State of Illinois; and

(4) Specifications and plans accompanying said letter covering Contract No. six (6) of the Illinois Waterway for approval by the Mayor and Council of the City of Joliet. That at the regular meeting of the Council held on the above date all of the above described plans and specifications for Contract No. six (6) of the Illinois Deep Waterway were presented to said Council and a yea and nay vote was taken, called and recorded on the approval of said plans and specifications and said plans and specifications were unanimously voted for, passed and approved by said Council of the City of Joliet on the 5th day of October, A. D. 1925, and that said proceedings were thereafter duly entered of record and are now of record in Book "U" of the records in said department and office; that all the aforesaid official proceedings are taken from our official records, papers, entries, ordinances, resolutions and files of said City of Joliet entrusted to our official care and custody.

In Witness Wehereof we have hereunto set our hands and affixed the corporate seal of the said City of Joliet, in the County of Will and State of Illinois, this 19th day of October, A. D. 1925.

(Signed) WM. C. STROHM,
Commissioner of Accounts and Finances, of the City of Joliet, Illinois.

(SEAL)

(Signed) PHIL PECK,
City Clerk of the City of Joliet, Illinois."

WORK OF CONSTRUCTION MADE POSSIBLE.

The approval of these plans and specifications by the city will permit the construction of the retaining walls, five highway bridges, the tunnel under the river to be used for public utilities and the re-laying and connection of sewers and water pipes made necessary by waterway construction in the City of Joliet.

OTTAWA O. K'S. STARVED ROCK PLANS.

Negotiations with the authorities of the City of Ottawa, which had been carried on for several years, with reference to damages to the sewer system and public property of the city resulting from the construction of the Starved Rock lock and dam, were brought to a successful termination on November 19, 1925, when an agreement between the State and the City was reached. In consideration of the payment by the State of the gross sum of $30,481, the city approved the plans and specifications for Starved Rock lock and dam and appurtenant structures of the Illinois Waterway and covenanted to fill and seed Allen Park, to make all necessary installations and to perform all the work necessary to protect and restore the sewage system of the city, to maintain the efficiency thereof and to remove from time to time all sewage accumulations resulting from the construction of the waterway, and to release the State from all responsibility and liability in this regard. A copy of this agreement between the State and the City of Ottawa is made a part of this report.

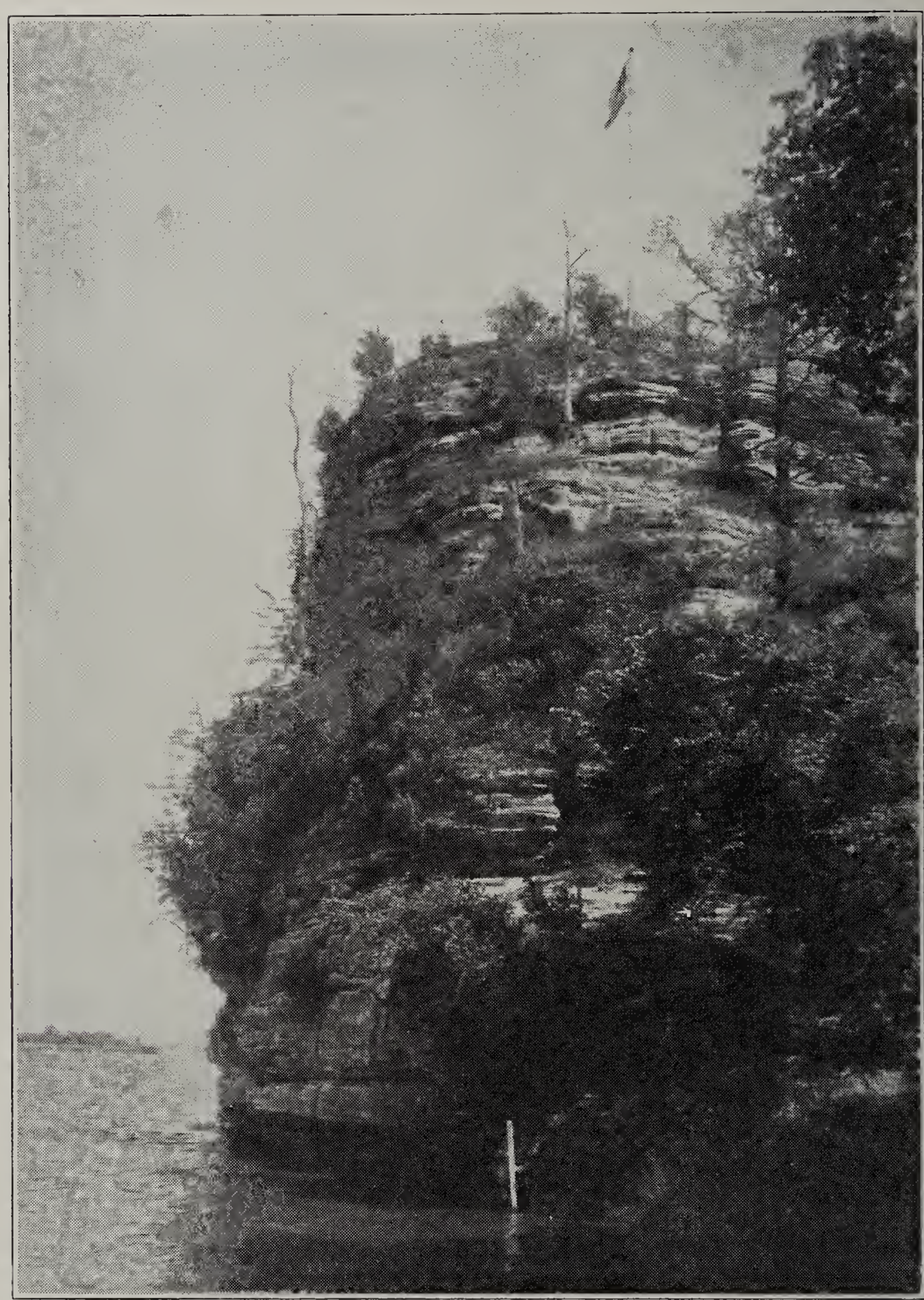
MEMORANDUM OF AGREEMENT BETWEEN THE STATE OF ILLINOIS AND THE CITY OF OTTAWA.

This agreement made an entered into this 19th day of November 1925, by and between the State of Illinois, acting through its Department of Purchases and Construction and the City of Ottawa by its Mayor and Commissioners, *Witnesseth*, that pursuant to the provisions of the Illinois Waterway Act of 1919 the said department has heretofore submitted to said City plans and specifications for construction work under Contract No. 2 of the Illinois Waterway for Starved Rock Lock and Dam and Appurtenant Structures, to which plans and specifications objections were filed by said City within thirty days, in accordance with the provisions of the Waterway Act, and

WHERAS, M. G. Barnes, Chief Engineer of the Division of Waterways and W. S. Richmond, Engineer for the City of Ottawa, were duly designated to review and check plans and specifications for the construction of the Illinois Waterway and its appurtenances, as perfected, in so far as they may interfere with or decrease the efficiency of the drainage or sewer systems of the City of Ottawa, as is more fully set out in a memorandum of agreement between said M. G. Barnes and said W. S. Richmond, a copy of which is hereto attached and made a part hereof, and

WHEREAS, Said engineers have made a finding in their said agreement that the approximate cost at the present time of the various constructions and other provisions, except funds for cleaning operations, are as follows:

Chester Street sewer $1,275.00; Shabbona Street sewer $2,350.00; Pine Street sewer $450.00; West Ravine sewer $1,100.00; Guion Street sewer $3,825.00; Allen Park sewer $200.00; Madison Street sewer $875.00; Third Avenue sewer $350.00; Pumping unit $1,000.00; $11,425.00, and;



Starved Rock. Opposite this historic spot, the State is building lock and dam No. 5 of the Illinois Waterway.

WHEREAS, The cost of filling the low areas of Allen Park so as to make the ground surface everywhere at least three (3) feet above the legal limit of normal pool level, the top six (6) inches of which shall be of suitable soil for sustaining lawn grass, and the seeding of the portion thus filled with suitable lawn grass seed is a proper expense of the State of Illinois, and is estimated to cost $2,181.00, and

WHEREAS, It is estimated that the annual cost for tools and labor in cleaning the lower portions of several of the sewers and outlets which discharge into the Illinois and Fox Rivers, and which will normally be partially or wholly submerged by the construction of the Illinois Waterway, will be $675.00, and,

WHEREAS, The cost of prompt removal of such sewage from time to time is a proper charge against the State of Illinois and has been fixed at $675.00 per year, which sum capitalized on the basis of four (4) per centum per annum (which is the rate of interest earned by the Illinois Waterway bonds), amounts to the sum of $16,875.00, and

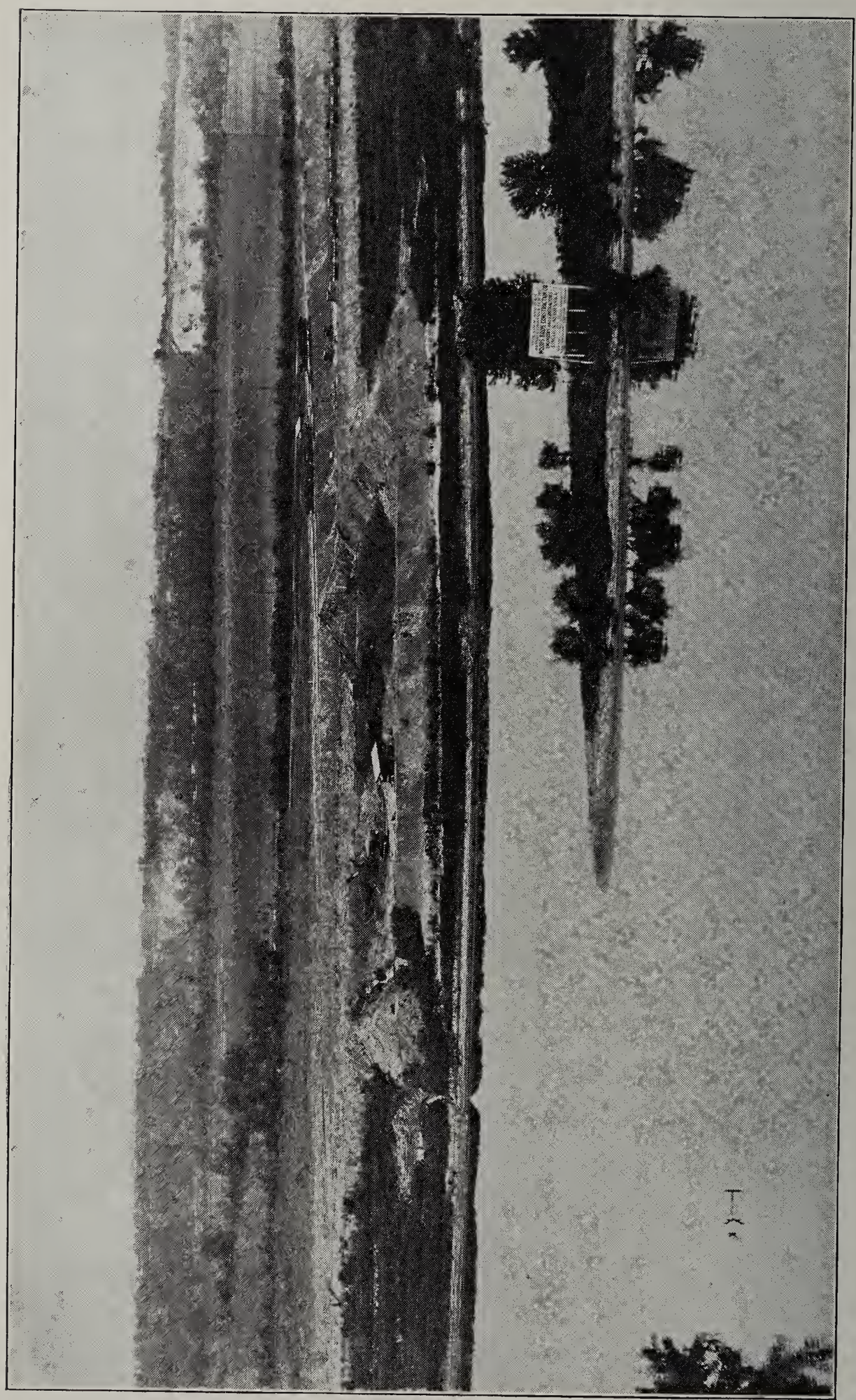
WHEREAS, The State of Illinois and the City of Ottawa mutually desire to compromise and settle all differences between them as to the proposed construction of the Illinois Waterway, and

WHEREAS, The State is desirous of being relieved of the necessity of performing the work and making the installations referred to in the said agreement of the said engineers, and the said City of Ottawa is willing to assume the responsibility for and to do the work and to construct the necessary installations to protect said city, and to approve the plans and specifications for said Contract No. 2 for the Illinois Waterway for Starved Rock Lock and Dam and Appurtenant Structures upon the payment to it by the State the sum of $30,481.00 covering the items heretofore enumerated,

Now, therefore, In consideration of the premises and the agreement of the State to pay to said City the sum of $30,481.00, prior to the beginning of construction work on said Contract No. 2 for the Illinois Waterway, the City of Ottawa does hereby approve the plans and specifications heretofore submitted covering Contract No. 2 for Starved Rock Lock and Dam and Appurtenant Structures of the Illinois Waterway, and does hereby convenant with the State of Illinois to fill the low portion of Allen Park and to seed the same; to do and perform all the work and installations necessary to protect and restore the present sewage system of the City of Ottawa and to remove, from time to time, any and all deposits resulting from the construction of the Illinois Waterway, from the sewers and outlets thereof, and to restore and maintain the efficiency thereof, hereby releasing the State of Illinois from all liability and responsibility in this regard.

It is further understood and agreed, That this compromise and settlement does not release the State of Illinois from any legal liability it may be under in the future to reimburse the City of Ottawa for any additional expense, due to the construction of the Illinois Waterway, which it may be under in the pumping of sewage at any City Sewage Disposal Plant, which may hereafter be constructed and placed in operation, without this, that should be constructed of such sewage disposal plant and the subsequent diversion of the city sewage from the Illinois and Fox Rivers obviate the necessity for cleaning the portions of the several sewers and outlets above referred to, the cost of which has been fixed as $675.00 per year, then the earnings of the said sum of $16,875.00 herein provided to be paid by the State of Illinois to the City of Ottawa, to provide an income of $675.00 per year, shall be applied by said City of Ottawa to the additional cost of pumping before any further charge shall be made to the State on that account; nor does this settlement release the State from any legal liability it may be under to restore the usability of the water main on the LaSalle Street bridge over the Illinois River, should the State reconstruct the drawspan of said bridge.

It is also understood and agreed, That the proposal and plans and specifications hereto attached or hereinbefore referred to, including the memorandum of agreement signed by said M. G. Barnes and said W. S.



Excavation work and Cofferdam for Starved Rock lock, now under contract. Picture taken from Lover's Leap, across the Illinois River. This lock will be 110 feet wide, 600 feet long, with a 16-foot lift. Contract price $1,475,832.

Richmond are all essential documents of this contract and are a part hereof as fully as if recited herein at length.

In witness whereof, The parties, by their proper officers duly authorized, have set their hands and seals on the day of the date hereof.

THE STATE OF ILLINOIS,
By-Department of Purchases & Construction.
(Signed) LESLIE SMALL, *Director.*

(SEAL)
ATTEST:
(Signed) WM. F. MULVIHILL,
Superintendent of Waterways.

CITY OF OTTAWA,
By
(Signed) GEORGE V. B. WEEKS, *Mayor.*

(SEAL)
CITY OF OTTAWA

(Signed) W. W. CURTIS, *City Clerk.*

GOVERNOR SMALL URGES FEDERAL AID.

On November 23, 1925, Governor Len Small called upon President Coolidge in Washington and among other things discussed with him the importance of the Lakes-to-the-Gulf Waterway, of which the Illinois Waterway is the connecting link. The Governor found the President an enthusiastic supporter of the Lakes-to-the-Gulf Waterway project.

In order to counteract as far as possible the efforts of certain interests which oppose the diversion of any water for any purpose from the St. Lawrence to the Mississippi watershed Governor Small on February 9, 1926, sent the following telegram to the President:

TELEGRAM FROM GOVERNOR SMALL TO PRESIDENT COOLIDGE.

"Chicago, Ill., February 9, 1926.

The President,
Washington, D. C.

Press dispatches announce that on Wednesday, February 10th, you are to be visited by a delegation from the Great Lakes Harbor Association in opposition to the continued diversion of lake water at Chicago for any purpose.

The subject of cheap transportation is of so much importance to the interests of agriculture, industry and commerce of the mid-continent, that, in view of the announced efforts of the opponents of diversion to enlist your influence with the Secretary of War and Congress against such diversion, I respectfully solicit your consideration of the following facts:

First. Our surplus grain belt is nearly one thousand miles further from the open seas than most other great grain exporting sections. The disadvantage which the American farmer suffers in competing in foreign markets by reason of the cost of this long haul to tidewater is also keenly felt by the manufacturers and merchants of the Middle West.

Second. The unfavorable location of the Upper Mississippi Valley in maritime trade relations demands the best and cheapest possible means of transportation that engineering skill and a reasonable expenditure of public funds can provide.

Third. The Panama Canal, constructed by the Federal Government has placed the mid-continent at a disadvantage in the matter of cheap transportation. Congress should relieve this economic handicap by an adequate appropriation of water and funds to develop the Lakes-to-the-Gulf Waterway.

Fourth. The State of Illinois, at an expense of $20,000,000 is constructing the Illinois Waterway. Within the past week the State has awarded a contract amounting to $1,475,000 for the third of the series of five locks and dams required to complete the connecting link between the Great Lakes and the Mississippi River system.

Fifth. The needs of navigation on the Illinois and Mississippi Rivers can best be served by a continuance of the present diversion of water from Lake Michigan.

Sixth. The average diversion for sanitation at Chicago for the past ten years has been from eighty-five hundred to ten thousand cubic feet per second. This should be continued for purposes of navigation. To stop all diversion or to cut the present diversion by one-half as has been suggested would reduce river depths below the possibility of successful navigation during low water stages and would be of little benefit to navigation in the Great Lakes.

The proper development of our inland waterways requires the continued diversion of water from Lake Michigan to the Mississippi river system. This question so transcends in importance all consideration of private interests or sectional rivalry, that I call these fundamental facts to your attention in full confidence that your final decision will be made upon the basis of permanent national welfare and sound public policy.

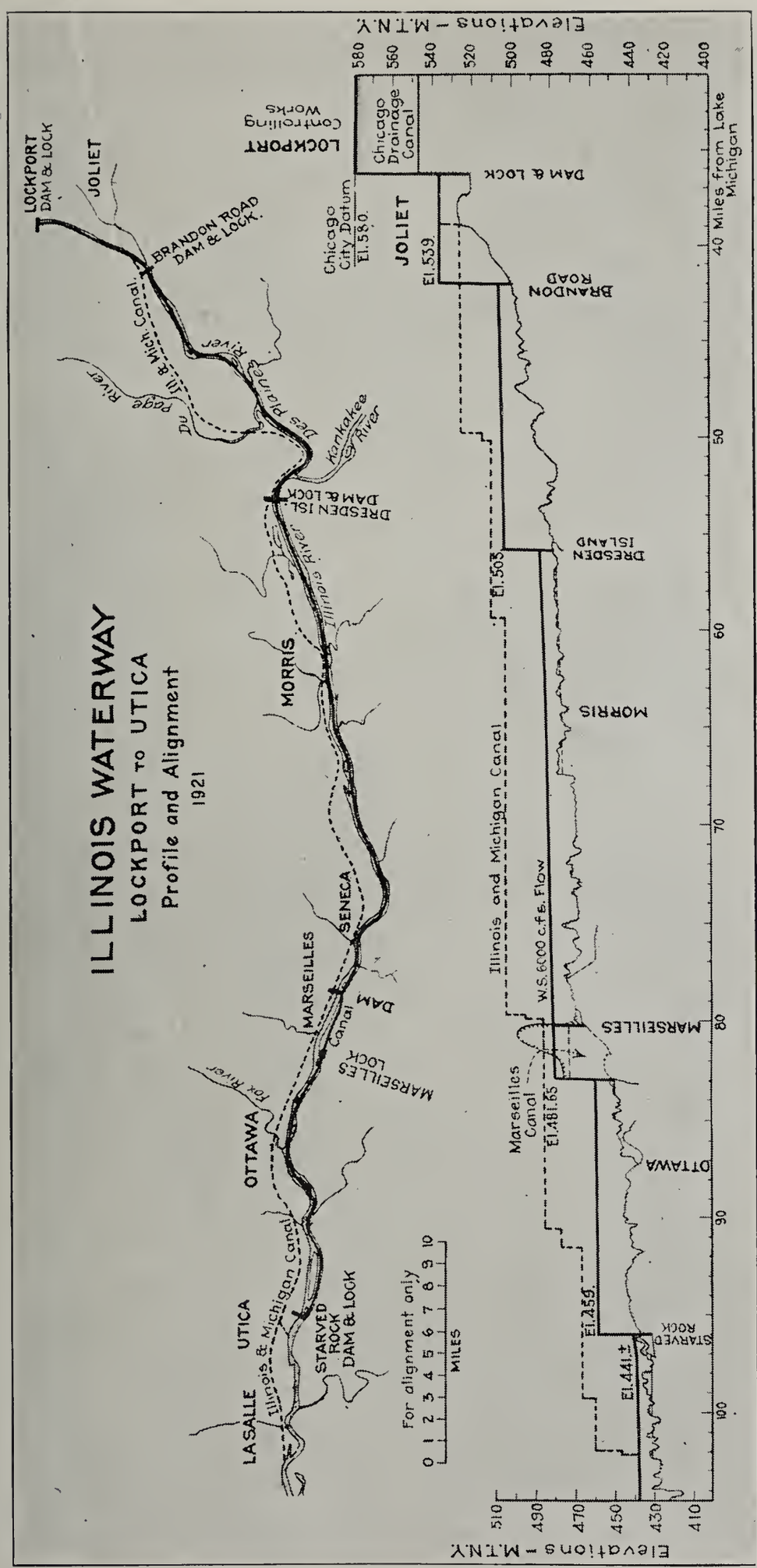
(Signed) LEN SMALL,
Governor of Illinois."

THE DIVISION OF WATERWAYS AT WASHINGTON.

With the approval of the Governor and of the Director of the Department of Purchases and Construction, the Superintendent of Waterways has taken an active, though inconspicuous, part in the promotion of Federal legislation for the improvement of the lower Illinois River and of the Mississippi River between the mouth of the Illinois and the Ohio as essential to the proper development of inland navigation through the Illinois Waterway, and to the creation of a nine-foot navigable channel extending from Lake Michigan to the Gulf of Mexico.

Early in December, 1925, I attended the Twenty-first convention of the National Rivers and Harbors Congress, at Washington. Secretary of Commerce Herbert Hoover, Senator Chas. S. Deneen and other speakers of national prominence were on the program. At the second session, Mr. R. J. Maclean of Detroit for the "Great Lakes Harbors Association," addressed the Congress, making the usual unwarranted attack upon our State, because of the diversion of water from Lake Michigan at Chicago.

I was the next speaker. A stenographic record of my remarks, as printed in the proceedings of the convention is included in this report, as follows:



Showing location of 5 big construction projects. Three of these projects are completed or under contract and plans for the others are about ready. The locks have a capacity for barge tows of 9,000 tons at a time.

"THE ILLINOIS WATERWAY."

Stenographic report of an Address by
William F. Mulvihill, Superintendent of Waterways
Before the
National Rivers and Harbors Congress,
Washington, D. C., December 9, 1925.

"Coming as I do, from the State of Illinois, and representing, as I do, the executive department of that State, I have been asked to talk about the Illinois waterway. But as Senator Deneen, this morning, made much of my speech, I am sure you will parden me, if, for a moment, I digress to suggest for the consideration of the gentlemen present, that the gentleman from Detroit who preceded me and who complained about the diversion of water at Chicago and talked about the rights of other cities around the Great Lakes, fails perhaps to recognize the fact that at the southern end of Lake Michigan, in the State of Illinois, is represented a population greater than that of all the other cities upon the Great Lakes and their appurtenant rivers combined.

LAKE LEVELS WERE LOW BEFORE CHICAGO DIVERSION BEGAN.

"If the industry of the gentleman had been equal to his self assurance, he would not have talked about the diversion at Chicago as the sole cause of lowered lake levels. By a trip from the platform to the rear of the hall he could have possessed himself of one of the hydrograph charts, showing from official records the water levels of the Great Lakes from 1860 to 1923, (reprinted for distribution by the National Rivers and Harbors Congress), and then he would not have been able to ignore the fact which may be unknown to him—that as far back as 1895-1896 the levels of Lakes Huron and Michigan were lower than any other time during the period referred to; and that was four or five years before the Chicago Drainage Canal was opened.

FEDERAL GOVERNMENT CONSTRUCTED GREAT LAKES HARBORS.

"I mention these facts to show you that there are some matters of equity which the gentleman who claims to represent the harbor interests of the Great Lakes sometimes overlooks. I would remind you also that the harbors, for the most part, are financed by the Government of the United States, and not by the people who live in the states where the harbors are located, and that Illinois and the people of the Mississippi Valley who are to be benefited by the development of navigation through the Illinois Waterway to the Mississippi Valley and to New Orleans and through the Panama Canal—that we all have rights that are to be conserved, by the great Government of the United States, equally with the rights of the people of the lake cities who have, he said, a fight for their lives. Gentlemen, they are not fighting for their lives; they are fighting for the right to have greater transportation facilities than they now have, while they oppose our chance to develop even a nine-foot waterway from the Lakes to the Gulf, for without an adequate appropriation of water from the Great Lakes through the Illinois and Mississippi Rivers efficient navigation is impossible.

THE ILLINOIS WATERWAY IS BEING CONSTRUCTED BY THE STATE.

"The Illinois Waterway is so called because, first, it is entirely within the State of Illinois and second, because the people of Illinois are paying for it without asking the rest of the states to contribute. The improvement of navigation—a proper channel for navigation between the Great Lakes and the Mississippi,—as Senator Deneen said this morning, has been talked of since the days when Father Marquette and his Indian guides came up the DesPlaines-Illinois River, carried their canoes across the continental divide and paddled down the Chicago River, which then flowed into Lake Michigan. It remained for the present generation in Illinois to undertake

the construction, in an adequate way, of a navigable channel and to translate the dreams of former years into a prospect of reality—because, unless unforeseen legal difficulties arise, within three years time the Illinois Waterway link will be completed and it will be possible for the gentlemen representing the manufacturing and industrial interests of all the States upon the Great Lakes—Minnesota, Wisconsin, Michigan and Indiana, as well as Illinois—to load their barges and transport their freight through the canal which the State of Illinois is providing, all the way down the Mississippi Valley and across country, as Mr. Hoover pointed out—because we are building our locks on the same basis as the Ohio River improvement—110 feet wide, 600 feet navigable length—and we are building four dams and five locks with a total lift of 126 feet, costing twenty millions of dollars, and that, together with the initial cost of the original Chicago drainage and ship canal, makes sixty millions directly spent exclusive of the Sanitary District's Calumet-Sag canal and the straightening of the Chicago River.

APPROVAL BY CONGRESS ONE HUNDRED YEARS AGO.

"The need of this internal improvement was early recognized by the Federal Government, and in 1822 and 1827 the Congress passed laws providing for the joining of the waters of the Illinois River with Lake Michigan. They did not say anything about how much water was to be taken, but the language of the Act said that it was for the purpose of joining the waters of the two. Manifestly, we could not take water up 140 feet out of the Illinois River and put it into Lake Michigan, thought I have no doubt my friend from Detroit would gladly repeal the laws of gravity so that all the waters of the Mississippi Valley should be made to run up hill and discharge into Lake Michigan in order that it might flow past the wonderful city in which he lives.

THE ILLINOIS WATERWAY IS A $20,000,000 PROJECT.

"In 1900 the Chicago Drainage Canal was completed and substituted for the Illinois and Michigan Canal for a distance of 36 miles. It was paid for by the people of the city of Chicago and vicinity, with the full knowledge and approval of the Federal Government, and was completed before the Act of Congress of 1899 was passed, though the water was not turned in until 1900. The voters of the State of Illinois in 1908 voted to burden themselves to the extent of twenty million dollars, to canalize the DesPlaines and Illinois Rivers between the end of the Sanitary District main channel at Lockport and the navigable water of the Illinois River at Utica. With an adequate appropriation of water for purposes of navigation we will have a nine-foot channel from Chicago through the drainage canal and through the Illinois Waterway, a distance of 102 miles toward the Mississippi River, from Lake Michigan.

AMEND FEDERAL PROJECTS FOR ILLINOIS AND MISSISSIPPI RIVERS.

"But I want you to know this—if you don't—that the present Federal projects for the development of the lower Illinois and the Mississippi provide for a seven-foot channel in the Illinois River from the end of the Illinois Waterway to the mouth of the river, and six feet in the Mississippi from the mouth of the Illinois River to St. Louis. Can you imagine the engineer corps recommending and the Congress approving projects which provide for a seven-foot channel from Utica to Grafton, to discharge into a six-foot channel from Grafton to St. Louis?

"The Illinois Waterway, considering its length, is probably the most important project for the development of inland navigation now under construction in the United States. It is the connecting link between Lake Michigan and the Gulf of Mexico. Its completion will permit profitable navigation between all ports on the Great Lakes and their appurtenant rivers, to and from river points in the Mississippi Valley and to the markets of the world.

CITY OF CHICAGO IS IN THE MISSISSIPPI WATERSHED.

"The Supreme Court of the United States, in the case of Missouri vs. Illinois, declared that the Congress of the United States, 'by its Acts of 1822 and 1827 has placed the city of Chicago in the Mississippi watershed.'

"The Federal Government has spent and is spending, and properly so, hundreds of millions of public funds in improving the ocean ports, the inland harbors and waterways of the United States, including seventy millions—Mr. Moore said eighty-five millions—for the development of a nine-foot navigable channel in the Ohio River from Pittsburgh to Cario. The citizens and the people of Chicago and the State of Illinois have spent, and are spending, upwards of sixty to seventy-five millions of dollars in constructing the Drainage Canal and Illinois Waterway.

WATER DIVERSION FOR SANITATION CONTROLLED BY SECRETARY OF WAR.

"By the recent decision of the Supreme Court of the United States in the Sanitary District case, the questions of sewage disposal and of lower lake levels have been relegated to the determination of the Secretary of War, who has decided upon a fixed program of sewage disposal to be followed by the Sanitary District of Chicago, and has required the posting of a bond to the extent of one million dollars as evidence that the Sanitary District is ready, willing and able to pay its share of the cost of regulating works in the eastern outlets of the Great Lakes as a partial compensation for the five and one-half inches of lowered lake levels, chargeable against the Chicago diversion.

A QUESTION OF NATIONAL IMPORTANCE.

"The gentleman from Detroit said, 'We have no water for sale.' Who gave the gentleman and his associates a title to the water? He said it belongs to all the people but it must all go past the city of Detroit. I submit to you gentlemen, that the people of the United States as a whole are as much interested in having the necessary appropriation of water from the Great Lakes system, for the purpose of developing navigation in the Mississippi Valley as they are in developing trade for the cities along the eastern course of the water which the gentleman from Detroit insists should all run east instead of allowing any of it to run south.

"We are asking from the Congress of the United States—not alone for the benefits of Chicago and Illinois but for the benefit of the states around about the Great Lakes and for the benefit of the twenty-six states in the Mississippi Valley—two things.

"First, an appropriation of water adequate and sufficient to provide a proper channel for navigation through the Illinois Waterway and the lower Illinois and Mississippi Rivers, and;

"Second, a modification of the existing projects with an appropriation of funds to the Secretary of War adequate to provide for the improvement of the lower Illinois and the Mississippi Rivers, so that we may have a nine-foot navigable channel from Chicago to New Orleans, as well as one from Pittsburgh to New Orleans.

MODIFICATION OF FEDERAL PROJECTS URGED.

"And in conclusion: When within three or four years the Illinois Waterway is completed—and the Secretary of War's present permit authorizes for five years the diversion of 8,500 cubic feet of water per second, which will allow us a nine-foot navigable channel in the Illinois Waterway —when the Illinois Waterway is completed we will have a nine-foot navigable channel, and then, when barges have been loaded at the ports of Minnesota, Wisconsin, Michigan and Indiana, as well as of Illinois, and have successfully navigated this nine-foot channel from Lake Michigan down to Utica in our State, we hope by that time the Federal Government will have improved the lower Illinois and Mississippi Rivers so these loaded barges may not get stuck in the mud or upon the sand banks of these rivers, as will happen if there is no modification of the present projects of the Federal Government relating to their development. (Applause)."

FEDERAL LEGISLATIVE SITUATION.

On account of the great importance of Federal legislation relative to the improvement of navigation in the Illinois River, and the diversion of water from Lake Michigan for navigation purposes, the Division of Waterways was represented in Washington for several months (February to July, 1926) during the first session of the Sixty-ninth Congress by its Chief Engineer, Mr. M. G. Barnes. The following historical report covering this subject, which also indicates the present status of pending Federal legislation, relating to the improvement of the Illinois River by the United States is submitted.

CONGRESS EARLY SOUGHT NAVIGABLE OUTLETS FROM GREAT LAKES TO SEA.

When the United States obtained independence from Great Britain it found itself possessed of a vast natural inland waterway of immense importance covering almost the entire northern border of the states. The Great Lakes forming this waterway system, however, emptied through the St. Lawrence River controlled by a foreign government. While these Lakes were of the greatest importance in developing the western wilderness there was no outlet or connection to the sea through United States territory. One of the most important questions for Congress to consider at that time was obtaining water communication between the Lakes and the Atlantic to the east, and the Lakes to the Gulf to the south, connecting these waters through the natural river system penetrating to the very heart of the country.

Early in the nineteenth century New York constructed a canal from the Hudson River to Lake Erie, which made New York the Empire state, and took from Philadelphia its commercial supremacy, and established New York city as the important entrepot on the Atlantic coast.

In the latter part of the seventeenth century the early French explorers discovered an outlet from the head of Lake Michigan southward through the DesPlaines, Illinois, and Mississippi rivers to the Gulf, with but a short portage between the Chicago and the Illinois rivers. This route was soon brought to the attention of the Federal Government as an important outlet to the south, over which the pioneers' commerce could be carried and by which the country could be developed.

GREAT BRITAIN DENIED UNITED STATES USE OF ST. LAWRENCE RIVER.

Great Britain had consistently maintained its supremacy over the St. Lawrence, and refused to allow the states to use that river on a parity with the citizens of Canada, hence, the importance of these two outlets to the sea both for commerce and for military purposes. In 1808 Albert Gallatin, Secretary of the Treasury, urged the construction of a waterway connecting Lake Michigan with the Illinois River, and pointed out its importance from a military and commercial standpoint. Congress took action in this matter in 1810, and by a resolu-

tion offered by Peter B. Porter, Congressman from New York, urged the construction of such a waterway. At that time all of northern Illinois belonged to Indian tribes. In 1816 these Indians granted a tract of land to the United States twenty miles in width through the valleys of the Chicago, DesPlaines and Illinois rivers, between Lake Michigan and Ottawa. The ceding of this land to the United States was for a small sum of money coupled with a promise that a canal would be constructed connecting Lake Michigan with the Illinois River. In 1817 Congress took further action in this matter, and by a resolution offered by John Holmes of Michigan, required the Committee on Rivers and Canals to investigate the expediency of such a canal.

BRITISH ATTITUDE LED TO CONGRESSIONAL ACTION FOR ILLINOIS RIVER IMPROVEMENT.

Following this resolution John Calhoun, Secretary of War, in 1819, recommended that this canal be constructed, and pointed out its importance from a commercial and military standpoint.

During the year previous, in 1818, Illinois became a state with a population of about 60,000 people, and following its admission into statehood Congress adopted a resolution to determine what was necessary to construct the canal through the public lands of the United States. Pursuant to this resolution Congress passed an act in 1822 authorizing the State of Illinois to construct this canal "through the public lands * * * connecting the Illinois River with the southern bend of Lake Michigan."

NEW YORK AND MICHIGAN LED EARLY FIGHT FOR ILLINOIS CANAL.

It thus appears that the early consideration of a canal connecting the Great Lakes to the Mississippi Valley was brought to the attention of Congress by representatives from New York and Michigan and by other eastern officials.

The Act of 1822 authorizing the State of Illinois to construct the canal and providing a right of way for that purpose did not provide funds for its construction.

At that time New York was rapidly completing its canal between Buffalo and the navigable waters of the Mohawk and Hudson rivers, and the great cost of such an enterprise was manifest. As stated above, the land traversed by the present Illinois and Michigan Canal was obtained from the Indians on the promise of the construction of a navigable waterway from the Lakes to the Illinois River. Territorial Governor Edwards suggested the following as a means of financing the canal:

> "Good faith, therefore, toward these Indians, as well as the concurring interest of the State and of the Union, seems to require that the execution of this truly national object should not be unnecessarily delayed, and nothing is more reasonable than that the expense should be defrayed out of the proceeds of the very property which was so ceded for the express purpose of having it done."

FEDERAL AID SOUGHT FOR CANAL CONNECTING LAKE MICHIGAN WITH ILLINOIS RIVER.

In 1826 the State Legislature memoralized Congress relating to the construction of the canal, which memorial reads:

"The memorial of the General Assembly of the State of Illinois respectfully represents: That the construction of a canal, uniting the waters of Lake Michigan with the Illinois River, will form an important addition to the great connecting links in the chain of internal navigation, which will effectually secure the indissoluble union of the Confederate members of this great and powerful republic. By the completion of this great and valuable work, the connection between the North and South, the East and the West, would be strengthened by the ties of commercial intercourse and social neighborhood, and the union of the States bid defiance to internal commotion, sectional jealousy and foreign invasion. All the States of the Union would then feel the most powerful motives to resist every attempt at dissolution. To effect so great and desirable an object your memorialists believe to be of sufficient importance to engage the attention and awaken the munificient patronage of a Government whose principle of action is the promotion of the general welfare."

CONGRESS GRANTED PUBLIC LANDS FOR I. & M. CANAL CONSTRUCTION.

In the following year, 1827, Congress passed an act in aid to the construction of the Illinois and Michigan Canal, which act in part reads:

"There be, and hereby is, granted to the State of Illinois, for the purpose of aiding the said State in opening a canal to unite the waters of Illinois River with those of Lake Michigan, a quantity of land equal to one-half of five sections in width, on each side of said canal, * * * and the said lands shall be subject to the disposal of the legislature of the said State, for the purpose aforesaid, and no other: Provided, that the said canal, when completed, shall be and forever remain a public highway for the use of the Government of the United States, free from any toll or other charge whatever, for any property of the United States, or persons in their service passing through the same."

Pursuant to this Act the State of Illinois began the construction of the canal, and made sufficient progress on it so that it was open to commerce in 1848 at a cost of $6,557,681.50.

DIVERSION OF WATER FOR CANAL PURPOSES DATES BACK TO 1848.

This short historical sketch indicates the early interest of the United States in the Lakes to the Gulf Waterway, and even before Illinois became a state the Acts of Congress in obtaining a water connection between Lake Michigan and the Mississippi River. Since the completion of the Illinois and Michigan Canal in 1848, water has been diverted from the Great Lakes watershed, by gravity, to the Mississippi watershed for canal purposes. The value of this waterwawy was immediately manifest. It became one of the most important elements in the development of the State of Illinois and adjacent territory to the west and south. Its commerce became so great that Congress again took cognizance of the situation, and by Act of Congress on June 23, 1866, ordered an investigation and report on the advisability of enlarging the Illinois and Michigan Canal. Pursuant to this Act the War Department made the necessary survey and recommended the enlargement of the Canal in language in part as follows:

" * * * The Illinois River seems to have been especially designed by nature as the line by which the waters of Lake Michigan are to be

connected with those of the Mississippi. * * * A moment's consideration will show that at no remote period the waters of the Lake must have been carried off by these streams, as well as by the St. Lawrence. * * * The data herein contained, together with the existence of a canal of limited capacity already in operation, demonstrate beyond a doubt that the waters of the Lake may be carried into the Illinois River through a navigable channel of any required dimensions and at a cost which cannot be regarded as excessive when the objects to be obtained are duly considered."

In commenting on the importance of the Lakes to the Gulf Waterway the Chief of Engineers in his report in 1868 said:

"There are but two ways in which we can thoroughly protect our northern frontier in times of war, and relieve ourselves of a continuous menace in times of peace. * * * As a military measure the construction of a canal will be effective and, fortunately for the country, this can be done at an expense which must be regarded as insignificant when compared with the objects to be obtained. But great as are the military reasons which favor the establishment of steamboat navigation between the lakes and the Mississippi, they are vastly transcended by those of a commercial and political character."

CONGRESS IN 1880 VOTED SEVEN FOOT CHANNEL FOR LOWER ILLINOIS.

In 1880 Congress adopted the present seven foot project for the improvement of the Illinois River from Grafton to LaSalle, the mouth of the Illinois and Michigan Canal. In a report and survey made by the Chief of Engineers in 1887 he says regarding the object and importance of this waterway:

"The ultimate object of this improvement is to provide a channelway from the lower end of Lake Michigan to the Mississippi River of sufficient capacity to accommodate large-sized Mississippi River boats, so that the products of the country may be carried from the lake to the Gulf without breaking bulk; also to enable vessels of war of considerable capacity to pass freely from the Gulf of Mexico into the defenseless waters of our northern lakes, should the exigencies of our foreign relations ever require this to be done.

"The United States and the State of Illinois have long been committed to the project of opening a water communication between the Mississippi River and the northern lakes of capacity sufficient for the wants of commerce and for the exigencies of our national defense, should these ever arise. * * * Pushing this improvement through to the lake, the connecting link will be formed which will join the northern lakes with the vast network of navigable rivers whose waters flow into the Gulf of Mexico on a scale to a certain degree commensurate with the importance of the commerce that will be affected by it. The mere fact that such a route is available will serve as a wholesome regulator to the rates that would be exacted by other methods of transportation were this one not in existence. * * * The problem of connecting Lake Michigan with the Mississippi River by a commodious Waterway, that could be used for commercial, military and naval purpose, has received attention, from our most thoughtful statesmen from the day of Albert Gallatin to the present. * * * The board of engineers appointed under provisions of the Rivers and Harbors Act, approved August 5, 1886, to examine and report upon the Illinois and Michigan Canal and the proposed Hennepin Canal, says in its report (House Ex., Doc. No. 79, 49th Congress, 2d session) that 'The waterway from Chicago to Grafton, on the Mississippi River, is a most important one, and when completed there is little doubt that it will richly pay for itself in the reduction and regulation of freights.' "

(See Annual Report, Chief of Engineers, 1887, page 2120.)

FEDERAL GOVERNMENT LONG SINCE COMMITTED TO ADEQUATE WATERWAY.

These reports and the various Acts of Congress and of the Legislature of the State of Illinois point out clearly the importance of this north and south water route, and show that from an early date both the United States and the State of Illinois have been committed to the construction of an adequate waterway that will properly serve the needs of commerce and likewise will be useful for military and naval purposes.

There being and having been no water other than the water of the Great Lakes to supply the summit level of any proposed artificial channel or canal with water for lockage and other canal purposes, it is evident that the intent of Congress has always been to obtain water from the Lake Michigan watershed for navigation purposes, and such water has in fact been used since the completion of the Illinois and Michigan Canal in 1848.

In 1870 the present Illinois Constitution was adopted, under which it was made unlawful to lend State aid to the construction of waterways. It was, therefore, impracticable to enlarge the canal with State funds in such a way as to make it adequate to meet the modern commerce of the day. Its usefulness as an actual means of transportation decreased and soon became of little consequence as a carrier of freight.

"ILLINOIS WATERWAY" COSTING $20,000,000 NOW BEING BUILT.

When this condition of affairs became manifest the State again appealed to Congress for aid in extending the navigation of the Illinois River to Chicago and Lake Michigan by means of a waterway adequate to meet the demands of commerce. Various surveys and reports were made, all indicating the importance of the waterway and the moderate cost of obtaining such means of transportation but no definite action looking to the fruition of the State's petition was taken. Consequently in 1908 the matter was placed before the voters of the State of Illinois, who voted an amendment to the Constitution permitting the Legislature to expend $20,000,000.00 in the construction of a waterway connecting the sanitary canal at Lockport with the navigable waters of the Illinois River at Utica.

The State is now actively engaged in constructing such a waterway, the minimum dimensions of which, as fixed by the Legislature, call for a channel at least 150 feet in width and eight feet deep in earth and ten feet in rock, with locks 110 feet wide and 600 feet usable length. The project for this waterway was approved by the War Department in 1919 upon plans contemplating a flow in the Illinois River of 6,000 cubic feet per second. With the present flow in the Illinois River a depth upward of nine feet will be obtained at no extra cost.

DIVERSION FOR SANITATION AUTHORIZED BY SECRETARY OF WAR IN 1899.

The opening of the Chicago sanitary canal, January 17, 1900, introduced another factor in the problem of obtaining a sufficient appropriation of water to meet the requirements of an adequate Lakes to Gulf Waterway. The Chicago Sanitary District is using large quantities of water for sanitary purposes, which has increased the natural discharge of the Illinois River and greatly improved it for navigation

purposes. The authority for the opening of the sanitary canal and drawing water from the Lake Michigan watershed for sanitation purposes is found in the action of the Secretary of War of May 8, 1899, prior to the opening of the canal. This permit reads as follows:

PERMIT.

"Whereas, by Section 10 of an Act of Congress, approved March 3, 1899, entitled, 'An Act Making Appropriations for the Constructions, Repair and Preservation of Certain Public Works on Rivers and Harbors and for other purposes,' it is provided that it shall not be lawful to alter or modify the course, the location, condition or capacity of the channel of any navigable water of the United States unless the work has been recommended by the Chief of Engineers and authorized by the Secretary of War prior to beginning the same; and whereas the Sanitary District of Chicago, a municipal corporation organized under the Laws of the State of Illinois, has constructed an artificial channel from Robey Street, Chicago, to Lockport, and has been heretofore granted permission by the Secretary of War to make certain improvements in the Chicago River for the purpose of correcting and regulating the cross section of the river so as to secure a flowage capacity of 300,000 cubic feet per minute, with a velocity of one and one-quarter miles an hour, it being intended to connect the said artificial channel with the west fork of the south branch of the Chicago River at Robey Street in the said city of Chicago; and whereas the said Sanitary District of Chicago has now applied to the Secretary of War for permission to divert the waters of said Chicago River and cause them to flow into the said artificial channel at Robey Street as aforesaid; Now, therefore, the Chief of Engineers having consented thereto, this is to certify that the Secretary of War hereby gives permission to the said Sanitary District of Chicago to open the channel constructed and cause the water of the Chicago River to flow into the same, subject to the following conditions.

"1. That it be distinctly understood that it is the intention of the Secretary of War to submit the question connected with the work of the Sanitary District of Chicago to Congress for consideration and final action, and that this permit shall be subject to such action as may be taken by Congress.

"2. That if at any time it becomes apparent that the current created by such drainage works in the South and Main Branches of the Chicago River be unreasonably obstructive to navigation or injurious to property, the Secretary of War reserves the right to close such discharge through said channel or to modify it to such extent as may be demanded by navigation and property interests along said Chicago River and its South Branch.

"3. That the Sanitary District of Chicago must assume all responsibility for damages to property and navigation interests by reason of the introduction of a current in Chicago River.

"Witness my hand this eighth day of May, 1899.

(Signed) R. A. Alger,
Secretary of War.
(Signed) John M. Wilson,
Brig. Gen. Chief of Engineers."

AUTHORIZED FLOW DETERMINED BY INTERESTS OF NAVIGATION.

At the time of this permit the Chicago River had not been enlarged or deepened to its present capacity and it was found that the amount of water withdrawn for sanitary purposes created a current sufficient to interfere with navigation in the Chicago River. Consequently on December 5, 1901, the Secretary of War limited the flow of water through the Chicago Canal to 4,167 cubic feet per second in the interests of navigation in the Chicago River.

The rapid increase in population of the city of Chicago soon rendered this amount of water inadequate for Chicago's sanitary requirement under the dilution method of sewage disposal. Consequently a greater amount of water has been diverted, and a serious controversy has resulted owing largely to the lowering of lake levels charged against this diversion.

Various bills have been introduced in Congress attempting to fix the amount of diversion for sanitary purposes, but Congress has failed to act, and diversion is continuing under permits from the Secretary of War.

ILLINOIS SEEKS FEDERAL SUPPORT FOR STANDARDIZED CHANNEL.

Now that the State's work in completing the Illinois Waterway from Lockport to Utica, a distance of 65 miles, is nearing completion, the State of Illinois through its representatives in Congress is asking that body for an appropriation of money and sufficient water from Lake Michigan to improve the lower Illinois River to a depth of nine feet and a channel width of at least 200 feet and the removal of the four old locks in the Illinois River between Utica and Grafton so that the channel dimensions of the Illinois River will be standard with those of the Ohio River and the lower Mississippi, thus affording a waterway of standard dimensions connecting the important commercial centers of the Mississippi Valley and adequate for modern barge traffic.

SUGGESTIONS MADE BY ILLINOIS DIVISION OF WATERWAYS.

The Committee on Rivers and Harbors of the House of Representatives passed a resolution dated April 14, 1924, requesting the War Department to review existing documents and report on the comparative cost of improving the Illinois River to a depth of seven, eight or nine feet and a channel width of 200 feet from Utica to the mouth of the river.

The Chief of Engineers assigned this work to District Engineer, Major Rufus W. Putnam. No public hearings were held during the preparation of this report. However, upon application to the Chairman of the Board of Engineers, this office was afforded the opportunity to hastily review the report before it was finally submitted to the Board of Engineers. From the study thus made it was found that the report did not meet the views of the State. Hence conferences were held and suggestions made covering certain phases of the report. The following communications were addressed to the District Engineer at Chicago:

SUPERINTENDENT MULVIHILL PRESENTS VIEWS TO U. S. DISTRICT ENGINEER.

STATE OF ILLINOIS

DEPARTMENT OF PURCHASES AND CONSTRUCTION

DIVISION OF WATERWAYS

Leslie Small, Director	CHICAGO OFFICE 950 Transportation Bldg. Chicago, Illinois	Wm. F. Mulvihill, Superintendent M. G. Barnes, Chief Engineer

"January 25, 1926.

"Major Rufus W. Putnam,
Corps of Engineers, U. S. A.
537 S. Dearborn St.,
Chicago, Illinois.

In re Value of Water Diversion at Chicago for Mississippi Valley Transportation Purposes.

Dear Sir:

My understanding is that the Congress of the United States, wishing to be fully advised upon the question of the amount of water which may properly be diverted from the Great Lakes System at Chicago in aid of inland waterway development, has requested the Engineer Corps and Secretary of War to make a report thereon with recommendations and that this question is now before you for consideration.

The subject under consideration is of so much importance to the interests of agriculture, industry and commerce, not only of the State of Illinois, and the entire Mississippi Valley, but to the whole nation, that I respectfully solicit your friendly consideration of the arguments herewith presented in support of the proposition that the ultimate welfare of the American people will best be served by the continued diversion of 8,500 to 10,000 cubic feet of water per second from the Great Lakes to the Mississippi River system.

STATE IS PUSHING "ILLINOIS WATERWAY" TO COMPLETION.

The State of Illinois, represented by the Department of Puchases and Construction, Division of Waterways, is rapidly pushing to completion the Illinois Waterway, which is the connecting link between the Great Lakes and Mississippi River systems.

Within the past week a contract for the construction of a lock and dam at Starved Rock to cost $1,475,000 has been awarded. This is the third of the five locks and dams required.

Representing, as I do in this matter, the Government of the State of Illinois, my own judgment may not be wholly free from bias, yet, it seems to me, that the question you are required to report upon so transcends in importance all considerations of self-interest, or sectional rivalry, that it should be fairly decided upon the broad basis of national welfare and public policy.

Such engineering facts as are herein contained and not otherwise credited have been supplied by Mr. M. G. Barnes, Chief Engineer of the Illinois Division of Waterways and his assistants.

BENEFIT OF LAKES TO GULF WATERWAY NOT LOCAL TO ILLINOIS.

The great agricultural region tributary to the Illinois and Mississippi Waterway, and in some measure dependent upon it for future relief, is now burdened by high taxation, and high cost of living and finds a poor market, at unsatisfactory prices, for its surplus products. A large part of the present financial trouble of the farmer is due to the high cost of transportation. The best thought of the Nation, in and out of Congress, has so far failed in devising satisfactory ways and means of aiding the farmers. President Coolidge and members of his cabinet have recommended the early completion of our inland waterway projects as one of the practical ways of aiding the farmers and other producers, and at the same time helping the dealers and consumers.

The surplus grain belt of the United States is nearly 1,000 miles further from the open seas than other great grain exporting sections, aside from Canada. This puts the American farmer at a great disadvantage in competing with other countries in foreign markets. The cost of this long haul to tidewater is also keenly felt by the manufacturers and merchants of the midcontinent.

WOULD RELIEVE MIDDLE WEST OF ECONOMIC HANDICAP.

The entire nation contributed to the building of the Panama Canal. The use of the Panama Canal has greatly reduced the cost of haul from

coast to coast and has given an advantage of from $300 to $1,000 per car load to those able to avail themselves of it. To relieve this economic handicap, the whole country should now aid the development of the cheapest possible means of transportation for the Middle West.

The experience of the Mississippi-Warrior barge service between St. Louis and New Orleans indicates that, with a dependable channel nine feet in depth, the cost of haul between Chicago and the Gulf can be greatly reduced and still leave a profit to the shipper.

Congress has placed that service on the Mississippi River to demonstrate the possibilities of modern barge transportation on the rivers of the Central West. To secure the fullest benefit of such service Congress should provide a proper channel connecting the large shipping centers, particularly Chicago, St. Louis and New Orleans. Happily this can now be done at a cost to the Federal Government of less than the savings resulting from one full year's use of barge service properly equipped.

MEETING NAVIGATION NEEDS REQUIRES ADEQUATE DIVERSION OF WATER.

More than two-thirds of the distance between Chicago and New Orleans now has a project depth of nine feet or greater. The improvement of the remaining reaches involves a diversion of water from Lake Michigan to supply the needs of navigation because of the fact that at low water stages the natural flow of the Illinois and Mississippi Rivers is insufficient to provide a navigable channel. This fact has been recognized by Congress for more than one hundred years and water has, in fact, been diverted for canal purposes since 1848,—in which year the Illinois and Michigan Canal was completed. From 1903 to 1925 the authorized diversion for sanitary purposes was limited to 4,167 cubic feet per second, but as a matter of necessity and to preserve the public health an average of 8,500 to 10,000 cubic feet per second has been diverted for ten years or more last past and the present permit from the Secretary of War to the Sanitary District of Chicago authorizes a diversion of 8,500 c. f. s., albeit for a five year period only.

AMOUNT OF DIVERSION NEEDED FOR NAVIGATION DISTINCT FROM SANITATION QUESTION.

Unfortunately a controversy has arisen as to the amount of diversion necessary. The argument at times has become so heated that unbiased consideration of the subject has been difficult. This controversy has arisen largely from diversion of water for sanitary purposes at Chicago, and has been opposed by residents of states bordering on the Great Lakes and by Canadian interests, who think that they are being deprived of property rights, and that the interests of navigation as well as riparian rights have suffered because of this diversion at Chicago.

With a few exceptions those who oppose the diversion admit that some water is necessary, and generally that a diversion of 4,167 c. f. s., should be allowed for sanitation and navigation, although this is a purely arbitrary amount, established in the Federal permit of 1903, and based at that time largely upon the requirement for sewage dilution under the Illinois Statute. The population having more than doubled and the present permit being for 8,500 c. f. s., the reason for reducing the diversion to 4,167 c. f. s., is not quite clear.

COMPARATIVE WATER NEEDS OF GREAT LAKES AND MISSISSIPPI VALLEY.

Navigation interests on the Great Lakes oppose any diversion on the theory that it affects the depth of water in the harbors and channels of the Lakes, but, as these harbors and channels have been deepened and enlarged by the Federal Government, and paid for with revenues collected from all the States, it does not seem unreasonable to ask that the National Government should also provide for a proper navigable depth in the Illinois and Mississippi Rivers, by such appropriation of water as is essential.

Hydraulic engineers seem generally agreed that the permanent diversion of 10,000 c. f. s., at Chicago lowers Lakes Michigan and Huron about 5½

inches, or slightly over one-half inch for each 1,000 cubic second feet of diversion, with a lesser effect upon the lower lakes. Since, however, the actual diversion at present and for the past ten years for sanitary purposes has averaged from 8,500 to 10,000 c. f. s., it must follow, that no increased damage to lake navigation could possibly result from Congressional action authorizing the continued diversion of such an amount for purposes of river navigation.

Let me suggest that in making the required report and recommendation to Congress the relative value to the public of the quantities of water involved, whether restored to the Great Lakes system or used to aid navigation in the Mississippi Valley system, can properly be presented.

Attention may be called to the fact that a reduction of the present flow to 4,167 c. f. s. would involve a loss to the Mississippi system of from 4,500 to 6,000 c. f. s. and that this at most would operate to restore the Lake Michigan-Huron levels about three inches. This almost negligible gain would be at the cost of reducing, by many feet, the navigable depth of the lower Illinois and Mississippi Rivers, with a consequent complete cessation of navigation during low water stages.

LAKE LEVELS MAY BE CONTROLLED BY REGULATING WORKS.

Upward of $121,000,000 has been spent in the improvement of the channels and harbors on the Great Lakes, of which amount the State of Illinois has paid its proportional share in taxes.

I am advised that the commerce of the Great Lakes exceeds 100,000,000 tons annually, and that the benefits to commerce exceed $250,000,000 annually. (See Warren report, pages 48). The people of Illinois enjoy these benefits probably to a greater degree than any other State. Hence it is obvious that the State of Illinois is as much interested as any State in the Union in navigation on the Great Lakes and in maintaining proper depths in the channels and harbors thereof.

Congress has at various times ordered surveys and studies of the lake levels by commissions made up of technical men, well qualified to report on such subjects. In some instances these commissions have been international. The unanimous report of all of these commissions has been that regulating works can be established in the outlets of the lakes that will fully compensate for any diversion that has now been made or is contemplated. The shipping interests and the power interests have agreed that such compensating works would add to the value of the Great Lakes for both navigation and power. There seems to be no question of the feasibility and practicability of such designs and the opposition, if any, must come from those not so situated that they can enjoy the benefits of a properly regulated lake level.

SUCCESS OF REMEDIAL WORKS IN OUTLET OF LAKE SUPERIOR..

At this time the elevation of the water surface of Lake Michigan-Huron and the lakes below is unusually low because of various reasons—the greatest contributing cause being the unusually light rainfall and large evaporation during the period from 1919 to date. The approximate amount of lowering of these lakes in the past seven years is about forty inches. This lowering has caused a great damage to the navigation interests of the lakes at a time when commerce on the lakes was heavy and the cost of haul unusually high.

The benefits of proper regulation can be seen by observing the results of the remedial works placed at the outlet of Lake Superior to compensate for water drawn for power purposes. These compensating works have held the level of Lake Superior at very nearly its normal height, while the waters from other lakes have been allowed to run off and lower the lakes to a damaging degree.

The regimen of the St. Clair and Detroit Rivers has undergone a marked change in the past twenty-five years, and has resulted in a flatter slope and less fall between Lake Michigan-Huron and Lake Erie than prevailed previous to that time.

The diversion from Lake Erie for power purposes and for canal purposes in New York and Canada has had its effect on the lowering of the lakes.

The diversion from Lake Michigan at Chicago for sanitary purposes has likewise had its lowering effect on the lake levels.

WHY LAKE LEVELS ARE NOW SO LOW.

The State of Illinois does not oppose any of those diversions or improvements for power, navigation or sanitation purposes that affect the lake levels. They are essential steps in the progressive development of our country and their damaging effects can be so fully compensated, by regulating works in the outlets to the Great Lakes that they should not be forbidden, but under proper control, such developments should be encouraged and fostered.

A study of the causes for the present lowering of Lake Michigan-Huron from 1919 to date shows the following cumulative effect:

1.	Unusually light rainfall and heavy evaporation	22 inches
2.	Decreased slope in St. Clair and Detroit Rivers	8 inches
3.	Diversion of water from Lake Michigan at Chicago	5 inches
4.	Retention of water in Lake Superior for power purposes during this dry period	3 inches
5.	Diversion of water from Lake Erie	2 inches
	Total lowering of Lake Michigan-Huron below normal	40 inches

Of this amount the lowering of water because of diversion at Chicago amounts to one-eighth of the total. Engineers may differ as to the details of this total lowering, but can agree that compensating works at the outlet of Lake Huron should be installed to compensate for those damaging effects and raise the lake to its normal height. Hence there seems to be no serious controversy or issue on this phase of the question.

DIVERSION SHOULD BE VIEWED FROM NATIONAL NOT SECTIONAL STANDPOINT.

The power interests argue that water has greater value in flowing to the sea via the St. Lawrence River than via the Mississippi River, and that they are damaged by the diversion at Chicago. This argument is without much force so long as the water is used inefficiently and it is only a small per cent of the total at Niagara Falls and little or none at all along the St. Lawrence River. Moreover a proper regulation of Lake Erie will add enormously to the value of the power rights at Niagara Falls.

As indicated hereinbefore, it is urged that this problem of diversion of water should be considered from a national viewpoint. It is believed that such diversion for navigation purposes is of paramount importance and that Congress may properly appropriate all the water that is necessary for an adequate waterway down the Mississippi Valley.

NAVIGATION NEEDS OF LOWER ILLINOIS AND MISSISSIPPI RIVER.

Let me call attention to some facts regarding the needs of navigation along the lower Illinois River, from Utica to Grafton, and the Mississippi River between the mouth of the Illinois and the mouth of the Ohio Rivers.

The State of Illinois at its own expense is constructing a waterway connecting the Chicago Sanitary Canal at Lockport with the navigable waters of the Illinois River at Utica, Illinois. The Illinois Waterway requires the construction of five locks which have been designed and are being built standard in horizontal dimensions with the locks on the Ohio River,—i. e. 600 feet usable length and 110 feet in width. These locks will have a depth of 14 feet over the miter sill at low water stages.

There are four locks in the Illinois River between Utica and Grafton, which are 350 feet long and seventy-five feet wide and have only seven feet in depth over the miter sills. They would limit the tonnage capacity of the fleets to about 35 per cent of the capacity of the locks on the Illinois Waterway. These old locks constitute a hindrance to navigation, and with a proper diversion of water for navigation purposes, may be removed with great benefit to shipping interests.

ALL OLD LOCKS SHOULD BE REMOVED AND PRESENT FLOW CONTINUED.

The operation and maintenance of these old locks would result in a perpetual expense to the United States estimated to be from $60,000 to $75,000 annually. Their retention would also add needlessly to cost of transportation and slow up the time of transit. It is, therefore highly desirable to divert sufficient water from lake Michigan to permit the removal of all these locks.

The opponents of the present diversion say the amount should be reduced to 4,167 c. f. s. The agricultural, industrial and commercial interests of the Middle West are asking that the amount be fixed at 10,000 c. f. s. Some of the advantages of the larger flow are enumerated below:

1. An examination of the maps accompanying the Ernst Report of August 26, 1905, shows that with the reduced flow there would be only 47 per cent of the distance with the full project depths of nine feet and a width of 300 feet. For 16 per cent of the distance the channel would be 500 feet wide. Whereas, a flow of 10,000 c. f. s. will give a channel depth of nine feet, 300 feet wide for 71 per cent of the distance with 500 feet width for the remaining 29 per cent of the distance.

For a seven foot channel depth, which might be used for lighter draft vessels or for fleets of empty barges, a diversion of 4,167 c. f. s. would provide a channel 500 feet wide for 29 per cent of the distance and 300 feet wide for 71 per cent of the distance. Whereas a diversion of 10,000 c. f. s. will provide a channel 500 feet 52 per cent of the distance and 300 feet 91 per cent of the distance. These wide waters are of great aid to navigation and permit of safer and more rapid movement of vessels.

WILL RAISE LOW WATER STAGE AND REDUCE CONSTRUCTION COST.

2. The larger flow will raise the low water stage of the Illinois River at Grafton about one foot and upwards of four feet at points further upstream. This added depth will lessen the cost of construction and maintenance and by placing more water under the keel of the vessel will lower the cost of vessel movement.

It is estimated that the retention of the smaller locks and reducing the flow to 4,167 c. f. s. would add at least 10 cents to the cost of haul on each ton of through freight. This would amount to $1,000,000 annually on a traffic of 10,000,000 tons, a sum sufficient to pay interest charges on the cost of a large fleet of boats.

3. Col. W. V. Judson estimated that the Government will be saved an expenditure of $3,448,500 in providing a 9 foot channel if the diversion is fixed at 10,000 c. f. s. and all locks removed instead of 4,167 c. f. s. with the locks retained.

4. A 10,000 c .f. s. diversion will increase the low water flow in the Mississippi River at Grafton about one-third (H. D. No. 2, 67th Congress, 1st Session, page 21). This will permit a wider and deeper channel in the Mississippi River and materially reduce the maintenance cost.

WHY NOT PROVIDE ADEQUATELY FOR PRESENT AND FUTURE.

Why should Congress be asked to make the larger expenditure of public funds which would be necessitated by the smaller flow?

Why should agriculture, industry and navigation interests forever be compelled to use a shallow, restricted channel at a high additional cost and increased hazard?

We feel that the development of commerce, the improvement of the condition of the grain belt farmer, and the best interests of the people of the United States, as a whole, require all public officials to deal generously with this problem and to provide a waterway not for today's use only but sufficient for all future needs.

By an appropriation of 10,000 c. f. s. of water for this purpose a sufficient money appropriation can be saved to cover the cost of regulating works in St. Clair River to equalize or overcome all bad effects of whatever nature due to such diversion.

WHAT ILLINOIS HAS CONTRIBUTED TOWARD THE LAKES TO GULF WATERWAY.

In carrying out their sewage disposal program the people of Chicago and vicinity have constructed two navigable channels, with a combined length of 55 miles and which form a part of the Lakes-to-Gulf Waterway. This has been done at a cost in excess of $75,000,000.

The State of Illinois is now extending this waterway to connect with the navigable waters of the Illinois River at Utica, a distance of 65 miles, at an estimated cost of $20,000,000. No part of this expenditure has been for power development.

WHAT OTHERS SAY ABOUT DIVERSION.

It has been the unanimous opinion of all engineers and commissions who have studied the needs of modern barge traffic on the Illinois and Mississippi Rivers that more than 4,167 c. f. s. diversion is required for the best type of waterway. A few of the later opinions are quoted as follow:

House Document No. 2, 67th Congress, 1st Session, contains report and estimated cost of a nine foot channel in the Illinois River. In that report page 17, paragraph 57, Colonel W. V. Judson says:

"57. For a 9-foot channel, with an increment of 4,167 second-feet, the cost either with dams retained or removed appears almost prohibitive, and the probability that Congress will limit the increment to 4,167 second-feet is, in my opinion, so remote that this hypothesis may be left out of consideration."

and in his recommendation, page 18, paragraph 65, Col. Judson says:

"65. In my opinion, to most reasonably conform to the probable conditions of the future, and 8-foot project should now be adopted, based on a 7,500 second-feet withdrawal for purposes of estimate and with all dams removed. Then should Congress place the limit of the amount of water to be withdrawn from Lake Michigan at 10,000 second-feet, which I deem probable, and, under proper conditions, advisable, that increment would of itself increase the depth of nine feet. The computations show that with all dams removed, an increment of 10,000 second-feet will increase the depths due to the increment of 7,500 second-feet by about 1.25 feet at Utica, about one foot at Peoria and Havana, and slightly less than one foot at the mouth."

THE BOARD OF ENGINEERS FOR RIVERS AND HARBORS.

The Board of Engineers for Rivers and Harbors, Gen. Harry Taylor, senior member, endorsed this report and recommended the modification of the existing projects in the Illinois and Mississippi Rivers so as to provide a channel 8 feet deep with a diversion of 7,500 c. f. s. See p. 5, paragraph 8, which reads:

"8. The question of the most advisable depth for a waterway covering this reach is most carefully considered in the reports under review. The conclusion was then reached that the most economical and advisable depth was 8 feet. Nothing has transpired since to change this conclusion, while the adoption of this depth for the Illinois Waterway, the assurance gained by experience that the 8-foot project from St. Louis to the mouth of the Ohio can be maintained by dredging at reasonable cost and the recent construction and operation of an extensive fleet of modern boats and barges on the lower Mississippi designed for such a depth, all tend to confirm it. Moreover, if the 8-foot depth proves successful and an increase to 9 feet is later deemed advisable this can be obtained by simply adding to the dredging plant engaged in maintenance operations. The board therefore reports that in its opinion it is advisable for the United States to modify the existing projects for the Illinois and Mississippi Rivers so as to provide a channel 8 feet deep from the vicinity of Utica, Ill., to St. Louis, Mo., approximately as proposed by the district and division engineers at an estimated cost of $1,310,000 for original work and $77,500 for maintenance for the Illinois River and $620,000 for original work and $75,000 for main-

tenance for the Mississippi River, a total of $1,930,000 for initial work and $152,500 for annual maintenance, provided, however, that the State of Illinois will convey to the United States such rights and title to the locks and dams at Henry and Copperas Creek as may be considered necessary to permit their removal."

NOTE: The Illinois Legislature by the Act of June 21, 1919, as amended, has authorized the Department of Purchases and Construction to make contracts regarding or to cede to the United States the State property at Henry and Copperas Creek.

THE CHIEF OF ENGINEERS OF THE UNITED STATES.

The Chief of Engineers, Major Gen. Lansing H. Beach, concurred in these views in the following language: (See page 2, pars. 2 and 3.)

"2. At the request of the board reports have been submitted by the district and division engineers concerned, covering details and estimates on which to base replies to the questions propounded in the resolutions. As the original reports now under review, together with the more recent ones just mentioned, contain full description of the waterway it is not considered necessary to repeat the information contained therein but rather to answer specifically the question asked relative to present costs. The committee desires information as follows:

"(a) The cost under existing conditions of an 8-foot channel in the Illinois River between Utica and the mouth.

"(b) The cost under existing conditions of a 9-foot channel from a point in the Illinois River in the vicinity of Utica, Ill., to a connection with the 9-foot channel in the Mississippi River at or below Cairo, Ill.

"In view of the inquiry for an 8-foot estimate for the Illinois River and the fact that the project depth for the Mississippi River from St. Louis to the mouth of the Ohio is eight feet, the board deems it advisable to include an estimate for an 8-foot depth to cover the intermediate reach between the mouth of the Illinois River and St. Louis in order that a through channel of this depth may be considered if desired.

OLD LOCKS AND DAMS AN OBSTRUCTION TO NAVIGATION.

"3. It will be seen from the district engineer's report that the estimates for the Illinois River are largely influenced by the amount of water discharged into it through the Chicago Sanitary Canal. The present permit authorizes a withdrawal of 4,167 second feet from Lake Michigan, but apparently the actual amount withdrawn is about 8,500 second-feet. Estimates are given for a flow of 4,167, 7,500 and 10,000 feet. The district engineer believes that the minimum that will be withdrawn from Lake Michigan is 7,500 second-feet and that it may eventually reach 10,000 second-feet. The effect of this additional volume of water will be readily understood when it is considered that the normal low-water flow in the Illinois River is only about 500 second-feet. The existing locks and dams were found necessary to secure the project depth of seven feet when the normal flow only was available. With the increased volume of 4,167 feet, they are of doubtful necessity in connection with either an 8 or 9-foot channel and with the probable minimum increment of 7,500 second-feet, or possibly 10,000 second-feet, the locks and dams become an obstruction to navigation rather than an aid and should be removed."

These recommendations and estimates are based on a diversion of 7,500 c. f. s. with the statement that if the flow is fixed at 10,000 c. f. s. a 9-foot depth in the Illinois River will be obtained.

COST OF REGULATING WORKS TO CONTROL LAKE LEVELS.

On March 25, 1920, the Chief of Engineers instructed Col. Judson to co-operate with the trustees of the Sanitary District of Chicago on matters relating to diversion from Lake Michigan. I quote from Col. Judson's report a portion of paragraph 8 that relates to the cost and operation of regulating works designed to compensate for a diversion of 10,000 c. f. s.

"8. The Sanitary District has had studies made by Mr. Francis C.

Shenehon, a competent hydraulic engineer, for regulating and compensating works in the Niagara River and at the Galops Rapids in the St. Lawrence below the lower end of Lake Ontario. Mr. Shenehon has prepared preliminary plans and estimates for the works above mentioned. He estimates that regulating works in the Niagara River would cost approximately $1,224,000 and those at the Galops Rapids approximately $1,000,000. It is understood that the Sanitary District, if the engineering propositions of Mr. Shenehon are approved by the United States, proposes to turn over to the latter the amount required for the construction of the works above described, the maintenance and operation of the same to be at the expense of the United States. These works, it may be said, contemplate a diversion of 10,000 cubic feet per second from Lake Michigan to the Drainage Canal. Digests of these two projects as prepared for me by Mr. Shenehon at my request are as follows:

DIGEST OF NIAGARA REGULATIONS PROJECT.

"The Niagara River Regulation contemplates slackwater, vessel draft betterments in Lake Erie, the Detroit River, Lake St. Clair River, Lake Michigan and Huron and St. Mary's River to the locks at Sault Ste. Marie.

"The loss of draft due to a diversion of 10,000 second feet at Chicago is about five and one-half inches. In a low water period such as the ten years 1893-1902, the regulation proposed will add over 14 inches to the depth of Lake Erie and Lower Detroit River; over 10 inches to Lake St. Clair, the Upper Detroit River and the Lower St. Clair River, with proportionate increase in St. Mary's River. In a decade of more plentiful supply, the average betterment is less. because no increase in lake stage is practicable at flood height. The regulation will compensate for lowerings due to all anticipated diversions at Chicago, in the Welland and Erie Canals and in the Niagara River for power purposes, and the regulation is accomplished without danger of riparian damage from flood stages.

"The excess flow of May to August inclusive is saved to hold up Lake Erie level during the season of navigation. The Niagara River runs free from January to March inclusive, to avoid flood stages, to give unimpeded passage for ice and to add water for power purposes during the season of ice complications. Water power is the beneficiary of the larger winter flow, which averages 17,000 second feet in January and February, more than offsetting a diversion of 10,000 second feet at Chicago."

OFFICIAL COMMENT ON COL. WARREN'S REPORT IN RE DIVERSION OF WATERS.

In reviewing the 1921 Warren report on the "Diversion of Water from the Great Lakes and Niagara River," the Board of Engineers, Gen. Taylor, senior member, said:

"There should be no limitation to the diversion of water actually needed for the supply of navigation canals, *and no difficulty will be experienced in remedying the losses of depth caused by the small diversion of this kind.*" (See Warren Report, p. 39, par. 71). (Italics ours).

After a very exhaustive study Col. Warren recommends that the diversion at Chicago be limited to 10,000 c. f. s. (P. 101, Par. 183).

In that same report the Board of Engineers recommend that the flow be limited to 6,800 c. f. s. (See p. 56, Par. 116).

Chief of Engineers Lansing H. Beach concurs in the recommendations, with reservations, in the following language.

"I concur, except so far as relates to the diversion to be permitted to be made by the Chicago Sanitary District. In respect to this, the trustees of the district have already been advised that the Chief of Engineers would not recommend to Congress any diversion greater than 250,000 cubic feet per minute, the limit set in the permit of the Secretary of War dated January 17, 1903, until the district had worked out and presented a suitable and comprehensive plan for treating its sewage so as to render it inoffensive and innocuous, and at the same time reduce to a minimum the quantity of water necessary for its dilution and transportation. This office has been informed that the Sanitary District is now making the necessary studies

and that plans based upon them will ultimately be presented for the approval of the War Department. Decision as to the diversion of the Chicago Sanitary Canal should therefore be deferred."

MATERIAL CHANGES DEVELOPED SINCE DATE OF WARREN REPORT.

Since that time conditions have changed very materially:

(1) The Supreme Court of the United States has sustained the authority of the Federal government to restrain the Sanitary District's diversion to the 4,167 c. f. s. authorized by the permit of January 17, 1903;

(2) The Sanitary District has accepted the orders of the Secretary of War, regarding the installation of sewage purification works so that the effluent discharged into the Illinois-Mississippi Waterway will not be offensive or injurious to the public health;

(3) The Secretary of War has issued to the Sanitary District a new permit authorizing a continuance for five years of a diversion of 8,500 c. f. s. for purposes of sanitation; and,

(4) The Sanitary District has posted with the Federal Government a bond of $1,000,000 guaranteeing payment of its share of the cost of constructing regulating works in the outlets of the Great Lakes to restore lake levels and to protect future navigation and power interests therein, due to a diversion of 10,000 c. f. s. at Chicago.

It is hoped that these changed conditions have obviated most of the objections contained in the above quoted and former official reports, and that it will be possible, at this time, conscientiously to recommend that the diversion of 8,500 to 10,000 cubic feet per second, which has heretofore been considered essential for purposes of sanitation, may properly be appropriated by Congress for purposes of inland navigation and for the proper and economical handling of water-borne commerce between the Great Lakes and the Gulf of Mexico.

SUMMARY OF CONCLUSIONS.

1. The unfavorable locations of the Uppper Mississippi Valley in maritime trade relations demands the best and cheapest possible means of transportation that engineering skill and a reasonable expenditure of public funds can provide.

2. The Panama Canal, constructed by the Federal government, has placed the mid-continent at a disadvantage in the matter of cheap transportation. Congress should relieve this economic handicap by an adequate appropriation of water and funds to develop the Lakes-to-the Gulf Waterway.

3. The State of Illinois, at an expense of $20,000,000 is rapidly completing the Illinois Waterway, the connecting link between the Great Lakes and Mississippi River systems.

4. The needs of navigation on the Illinois and Mississippi Rivers can best be served by an appropriation of 10,000 c. f. s. from Lake Michigan.

5. The old locks on the Illinois River are inadequate for present day needs. They are a hindrance to modern barge traffic. Their retention would result in great loss in time of transit and unnecessary cost of transportation. When the Illinois Waterway is completed and traffic is once established, this loss is estimated to be at least $1,000,000 per year if the diversion is cut to 4,167 c. f. s.

6. The retention of these old locks would require an extra annual appropriation for maintenance of from $60,000 to $75,000.

7. An appropriation of 10,000 c. f. s. will lessen the cost of providing a 9-foot channel more than enough to pay the cost of compensation works on the Great Lakes.

8. The importance of navigation on the Great Lakes demands regulation of the lakes to fully compensate for all diversions and maintain a satisfactory stage of water during periods of drouth.

9. Experience gained in regulating Lake Superior for power uses demonstrates that the lake levels can be held to a satisfactory stage.

10. The average diversion at Chicago for the past ten years has been from 8,500 to 10,000 c. f. s. To cut this diversion to 4,167 c. f. s. would raise

water levels in the Great Lakes not more than 3 inches, and would reduce river depths in the Mississippi below the possibility of successful navigation during low water stages.

11. Under an agreement with the Secretary of War the Chicago Sanitary District has bonded itself to pay its proportional part of regulating works to compensate for a diversion of 10,000 c. f. s.

12. In view of all the facts, circumstances and conditions above enumerated it would seem that Congress is fully justified in making an appropriation of 10,000 c. f. s. of water and sufficient money to complete an adequate 9-foot waterway from Chicago to New Orleans.

Respectfully submitted,
(Signed) WM. F. MULVIHILL,
Superintendent of Waterways."

CHIEF ENGINEER BARNES SUPPLIES DETAILED INFORMATION.

STATE OF ILLINOIS
DEPARTMENT OF PURCHASES AND CONSTRUCTION
DIVISION OF WATERWAYS

Leslie Small, Director

CHICAGO OFFICE
950 Transportation Bldg.
Chicago, Illinois

Wm. F. Mulvihill,
Superintendent
M. G. Barnes,
Chief Engineer

"February 1, 1926.

Major Rufus W. Putnam,
Corps of Engineers, U. S. A.
537 South Dearborn Street,
Chicago, Illinois.
Dear Major:

Under date of January 25 I appeared before you with Mr. William F. Mulvihill, Superintendent of Waterways, in presentation of argument against the reduction of the present diversion from Lake Michigan.

At that time Mr. Mulvihill presented a written statement showing that if the present diversion is reduced to 4,167 c. f. s. and the present four old locks are retained in the lower Illinois, added cost of transportation based on a ten million ton traffic would be $1,000,000 annually.

At that time you requested me to prepare detailed statement showing how this figure was arrived at. Supplementing Mr. Mulvihill's paper I submit below argument on which that figure was based.

The delays and extra cost to navigation are made up of the following factors:

1. Delays at locks and restriction of fleet cargo capacity.

II. Shallower draft and narrower channels, which result in a greater consumption of coal for towage.

III. Additional hazards and delays caused by narrow channels.

IV. Greater maintenance cost in both the Illinois and Mississippi Rivers.

I. DELAYS AT LOCKS AND RESTRICTION OF FLEET CARGO CAPACITY.

In treating this phase of the question I have accepted for the river locked channel, the fleet suggested in your report, i. e., two barges each 200 feet by 45 feet in one fleet. I have also assumed that these barges would be towed in tandem, as this is the most economical way of towing barges of this size.

In the open river channel I have assumed a fleet of the horizontal dimensions of the locks now being built in the Illinois Waterway, i. e., eight

barges 200 feet by 36 feet and one tow-boat. This entire fleet would be locked through the Illinois Waterway locks at one lockage.

I have also assumed an annual balanced traffic of 5,000,000 tons and an additional unbalanced tonnage or one way traffic of 5,000,000 tons.

The transportation costs were then arrived at by reference to the Tow Boat Board Report (H. D. 867-63-2) as follows:

"Barge—type No. 4 plate 3.

Displacement from plate 58 by interpolation and 82 per cent net at full load.

Towing resistance per ton from plate 52 using 2.15 pounds per ton of gross displacement for 9,000-ton fleet and 2.42 pounds per ton for two barges in tandem on the assumption that the total resistance would be the same as for a single barge.

The report shows no data for two barges tandem.

ADDITIONAL DATA USED.

Wages and subsistence per month at $1,200 plus $0.40 per IHP plus $0.15 per ton cargo capacity.

Barge cost at $25.00 per ton of cargo capacity.

Towboat cost at $250.00 per IHP required for towing.

Assumed 3,600 towing hours or one-half time for ten months.

Coal at two and one-quarter pounds per H. P. hr. at $3.00 per ton.

Depth of water nine feet. Draft at full load 6.5 feet.

TABULATION OF DATA.

Size of fleet	2 barges	8 barges
Arrangement of barges	Tandem	3x3 with towboat
Size of barge	200'x45'	200'x36'
Total gross displacement	3,500 tons	11,280 tons
Total net displacement at 82 per cent gross	2,880 tons	9,250 tons
Total cost of barges	$72.000	$231.000
Total cost of towboat	$76,000	$215,000
Power of towboat at barge capacity	303 IHP	860IHP
Speed of fleet at barge capacity	4 MPH	4 MPH
Speed of fleet empty	7 MPH	6 MPH
Operating cost TM cargo capacity loaded	1.176 mills	0.8985 mills
Operating cost TM cargo capacity empty	672 mills	0.6 mills
Value of 1 hr. delay loaded or empty	$13.60	$33.20
Value of 1 hr. delay loaded or empty per ton	4.7 mills	3.6 mills

DATA FOR YEAR.

Balanced cargo	5,000,000 tons	5,000,000 tons
Ton Miles on 400 mile haul	2,000,000,000 TM	2,000,000,000 TM
No. Lockage (4) Lower, Ill., (2)	13,900 (5)	10,800
Lost time for lockage Ill., R (20m)	4,634 hrs. (24M)	4,320 hrs.
No. Lockage (5) Ill. Waterway	8,675	2,700
Lost time for lockage Ill. Wy. (20M)	2,892 hrs. (30M)	1,350 hrs.
Cost open channel navigation	$2,352,000	$1,797,000
Cost lost time Ill. Waterway locks	39,100	44,800
Total for open Illinois River	$2,391,100	$1,841,800
Cost lost time Ill Hiver locks	62,500	143,500
Total	$2,453,600	$1,985,300
Cost per ton mile	1.23 mills	1.00 mill

COST OF ADDED 5,000,000 TON 1-WAY HAUL.

Open channel loaded	$2,352,000	$1,707,000
Open channel empty	1,344,000	1,200,000
Lost time Illinois Waterway locks	78,200	89,600
Lost time Illinois River locks	125,000	287,000
Total	$3,899,200	$3,373,600
Cost per ton mile	1.92 mills	1.69 mills

This argument is based on ideal conditions and an equal distribution of tonnage throughout the season. Neither of these conditions can be realized, and hence the transportation cost will be in excess of the figures shown.

This argument shows that the transportation cost for 5,000,000 tons of balanced traffic through the lock type channel with small fleets cost $2,453,-600, whereas the transportation cost through the open channel with large sized fleet is only $1,841,800, or a difference of $611,800 for the 5,000,000 tons. If this item is capitalized at five per cent, it shows that an additional expenditure of $12,236,000 could be expended to obtain a channel wide enough to accommodate the large size fleet.

Referring to the unbalanced traffic it will be seen that the transportation cost for the lock type channel is $3,899,200, whereas with the open channel type the transportation cost is $3,086,600, or a difference of $812,-600. This represents a capital of $16,252,000, or for the 10,000,000 tons traffic the added cost to transportation is $1,424,400, or at five per cent this represents a total capital of $24,488,000.

SMALL LOCKS TEND TO CONGESTION AND DELAY OF TRAFFIC.

To accommodate this traffic it would require an average use of the locks throughout the season of four hours per day for the balanced traffic and eight hours per day for the unbalanced traffic, assuming that the traffic is so timed that there is but one fleet at a lock at one time. It is not practicable to so time the fleets nor is it fair to assume that the fleets will be distributed equally throughout the entire navigation season. Therefore, greater congestion will result and at times the locks would be used at their full capacity, if, indeed, fleets are not held up waiting passage, the result being that greater delays will be experienced and therefore added cost for transportation through the lock type channel. Before traffic has reached this tonnage, practical operation would require the construction of another set of locks alongside the present ones.

The cost of delays at the locks is based on the operating cost of the fleets as found by the above arguments. If the cost of delays is based on earning power of the fleets the total cost of delays will be upwards of three times the amount shown in the above computation.

For example, based on the operating transportation cost, the delays at the old Illinois River locks amount to $143,500 on the large fleets. If the loss is based on an earning capacity of three mills per ton mile and a speed of four miles per hour, which is slightly less than the speed attained by the Mississippi-Warrior Service, the cost of delays amount to $479,500, and by the same reasoning the cost of delays to the 5,000,000 tons of unbalanced traffic amounts to $509,500 or for the 10,000,000 tons total traffic the cost of delays based on the earning power amounts to $1,053,500.

II. SHALLOWER DRAFT AND NARROWER CHANNELS, WHICH RESULT IN A GREAT CONSUMPTION OF COAL FOR TOWAGE.

Experiments conducted by the Tow Boat Board and experiments on practical operation in the Hudson River shows that the decreased depth of channel has a decided retarding effect, causing the consumption of greatly increased quantities of fuel to atttain the same speed.

No detailed estimates of cost of the shallower channel, resulting in a reduction of flow from 10,000 c. f. s. to 4,167 c. f. s. has been made, but inasmuch as the average channel depth would be reduced from one to four feet or more, it is known that the additional cost of fuel would be material.

III. ADDITIONAL HAZARDS AND DELAYS CAUSED BY NARROW CHANNELS.

Here again no detailed computations can be made of the hazards to navigation because of the narrower channel. It is known that these hazards are present and their presence cause the navigators to slow up the speed

of their fleet, which delays time of transit, and, therefore, adds to the cost of transportation.

The decreased width of channel resulting from a reduction of flow to 4,167 c. f. s. is shown in the article presented to you by Mr. Mulvihill.

IV. GREATER MAINTENANCE COST IN BOTH THE ILLINOIS AND MISSISSIPPI RIVERS.

While not a direct cost to transportation, there will be a direct additional cost to Congress, both in maintaining the channel in the Illinois and Mississippi Rivers, and especially in the latter stream, and in the cost of operating the locks. In the operation of the locks this annual cost would probably equal or exceed $75,000. The extra cost of maintaining the channel is not so well known, but is material.

EXTRA WATER REQUIRED FOR SMALL FLEETS.

In forwarding the 5,000,000 tons of balanced traffic it will require 8,675 lockages through the Illinois Waterway to accommodate the small fleet, or a difference of 5,875 lockages. The average lift on these locks is 22.5 feet. Surplus water not needed for lockage purposes along the Illinois Waterway may be used for power purposes, and in planning the Illinois Waterway the Federal Power Commission were very insistent that the design of the Canal and the location and lift of the locks should be such as to make the best possible use of the water for both power and navigation.

Assuming a value of this water power at $30.00 per electric H. P., the loss occasioned by these extra lockages amounts to $18,500 per year.

For the unbalanced traffic of 5,000,000 tons the economic loss of water amounts to $37,000 per year, or a total maximum loss for the 10,000,000 tons of traffic of $55,500 per year.

CONCLUSIONS.

The above argument shows clearly the advantage of open river navigation with sufficient water to create a channel of sufficient width and depth to accommodate fleets of boats that will fill the Illinois Waterway locks.

The argument also shows that, based on transportation costs only, the presence of the old locks costs the shippers $430,500 on a 10,000,000 ton traffic and based on the earning power, the cost to the shippers amounts to $1,053,500, or in excess of ten cents per ton of traffic.

To this figure must be added, if obtainable, costs resulting from delays and hazards shown in Paragraph II and III.

These computations also seem to indicate that the small fleet suggested by you is not the most economical fleet for this river, but, on the other hand, the computations show that a wide open channel affords the most economical means of transportation.

Respectfully submitted,

(Signed) M. G. Barnes,
Chief Engineer.

HISTORICAL BACKGROUND AND "ILLINOIS WATERWAY" LEGISLATION.

"February 15, 1926.

"Major Rufus W. Putnam,
Corps of Engineers, U. S. A.
537 S. Dearborn St.,
Chicago, Ill.
Dear Sir:

In compliance with your oral request for an outline of the history of proceedings that led up to the adoption and approval of the present plans for the Illinois Waterway, I submit the following brief outline from the records of this office.

The advantage of a waterway connecting the Great Lakes system with the Mississippi Valley system has been seen from the days of the early French explorers.

CONSTRUCTION AND BENEFITS OF THE ILLINOIS AND MICHIGAN CANAL.

In 1822 Congress came to the aid of Illinois with a grant for a right of way for a canal connecting Lake Michigan at Chicago with the navigable waters of the Illinois River at LaSalle, and in 1827 further aid was given to the State by a grant of each alternate section of public lands in a zone five miles wide on each side of the right of way previously granted. This congressional aid permitted the State to undertake the construction of the Illinois and Michigan Canal, which was completed in 1848.

The importance of this waterway was soon manifest and it grew to be a very important north and south transportation route through our State.

The Great Lakes system was its summit level and water was taken from Lake Michigan for lockage and other canal purposes. This waterway continued to function and exerted its influence until the latter part of the Nineteenth Century, when, in common with other canals built contemporaneously with the Illinois and Michigan Canal, it became obsolete because of its inadequate size to accommodate modern traffic.

The construction of the Illinois and Michigan Canal cost $6,557,681.50. Between the years 1860 and 1915 it carried upwards of 30,000,000 tons of freight. The Canal had a minimum depth of 6 feet. The width at the water line was sixty feet. The locks would accommodate boats about 103 feet long and seventeen feet beam.

OLD DAMS IN ILLINOIS RIVER CONSTRUCTED TO RAISE WATER.

The Illinois River below LaSalle proved to be too shallow during low water season to accommodate traffic from the Illinois and Michigan Canal and its improvement by locks and dams became essential. Navigation interests required a depth in the river of seven feet and to insure this depth the State Built a lock and dam at Henry, which was completed in 1872 at a cost of $400,000 and another at Copperas Creek which was completed in 1877 at a cost to the State of $347,747.51. In 1899 and 1903 the Federal Government completed locks and dams at LaGrange and Kampsville which carried to the Mississippi the channel improvement and linked the latter with the Great Lakes. These locks in the lower Illinois River were made 350 feet long and seventy-five feet wide. Since 1900 the Sanitary Drainage Canal has become the lake level section of the waterway between Lockport and Chicago.

When the Illinois and Michigan Canal had fallen into disuse, I am advised by former members of Congress that the people of Illinois, through their representatives in Congress, appealed to the Federal Government for an appropriation to construct the Lakes to Gulf Waterway of dimensions adequate to meet modern interstate commerce. The reply of Congress was in effect that Illinois had a greater interest in power than in navigation, and that Congress could not appropriate for power development. Consequently Illinois' delegation returned to the State and canvassed each county, advocating a constitutional amendment that would permit the legislature to bond the State in the sum of $20,000,000 for the construction of a deep waterway and the development of water power in connection therewith between Lockport and Utica.

NAVIGATION—NOT POWER—CHIEF CONCERN OF THE STATE.

Having in mind the importance and success of the old Illinois and Michigan Canal, and realizing that the income from power developed from surplus waters would, in part, defray the cost of development, the voters very readily voted and amendments to the Constitution permitting the Legislature to bond the State for $20,000,000 for the development of a deep waterway from Lockport to Utica, the vote on this proposition being: for, 675,898; against, 193,298; not voting 284,881.

TEXT OF CONSTITUTIONAL AMENDMENT OF 1908.

The language of the Constitutional Amendment is:

"*Provided, further*, that the General Assembly may, by suitable legislation, provide for the construction of a deep waterway or canal from the

present water power plant of the Sanitary District of Chicago, at or near Lockport, in the township of Lockport, in the county of Will, to a point in the Illinois River at or near Utica, which may be practical for a general plan and scheme of deep waterway along a route, which may be deemed most advantageous for such plan of deep waterway; and for the erection, equipment and maintainence of power plants, locks, bridges, dams and appliances sufficient and suitable for the development and utilization of the water power thereof; and authorize the issue, from time to time, of bonds of this State in a total amount not to exceed twenty million dollars, which shall draw interest, payable semi-annually, at a rate not to exceed four per cent per annum, the proceeds whereof may be applied as the General Assembly may provide, in the construction of said waterway and in the erection, equipment and maintenance of said power plants, locks, bridges, dams and appliances.

"All power development from said waterway may be leased in part or in whole, as the General Assembly may by law provide; but in the event of any lease being so executed, the rental specified therein for water power shall be subject to a revaluation each ten years of the term created, and the income therefrom shall be paid into the treasury of the State."

TENTATIVE PLANS FOR 24-FOOT WATERWAY PREPARED IN 1910.

After the passage of this constitutional amendment the State of Illinois prepared tentative plans for a deep waterway extending from Lockport to Utica, and in October, 1910, presented plans and arguments to a special board of engineers appointed by the Secretary of War to consider plans for a Lakes to Gulf Waterway.

NEW PLANS, 1915, NOT APPROVED BY SECRETARY OF WAR.

This threw the matter back into the General Assembly of the State of Illinois for revision of plans, and it was not until 1915 that revised plans were drawn that would meet the view of the General Assembly.

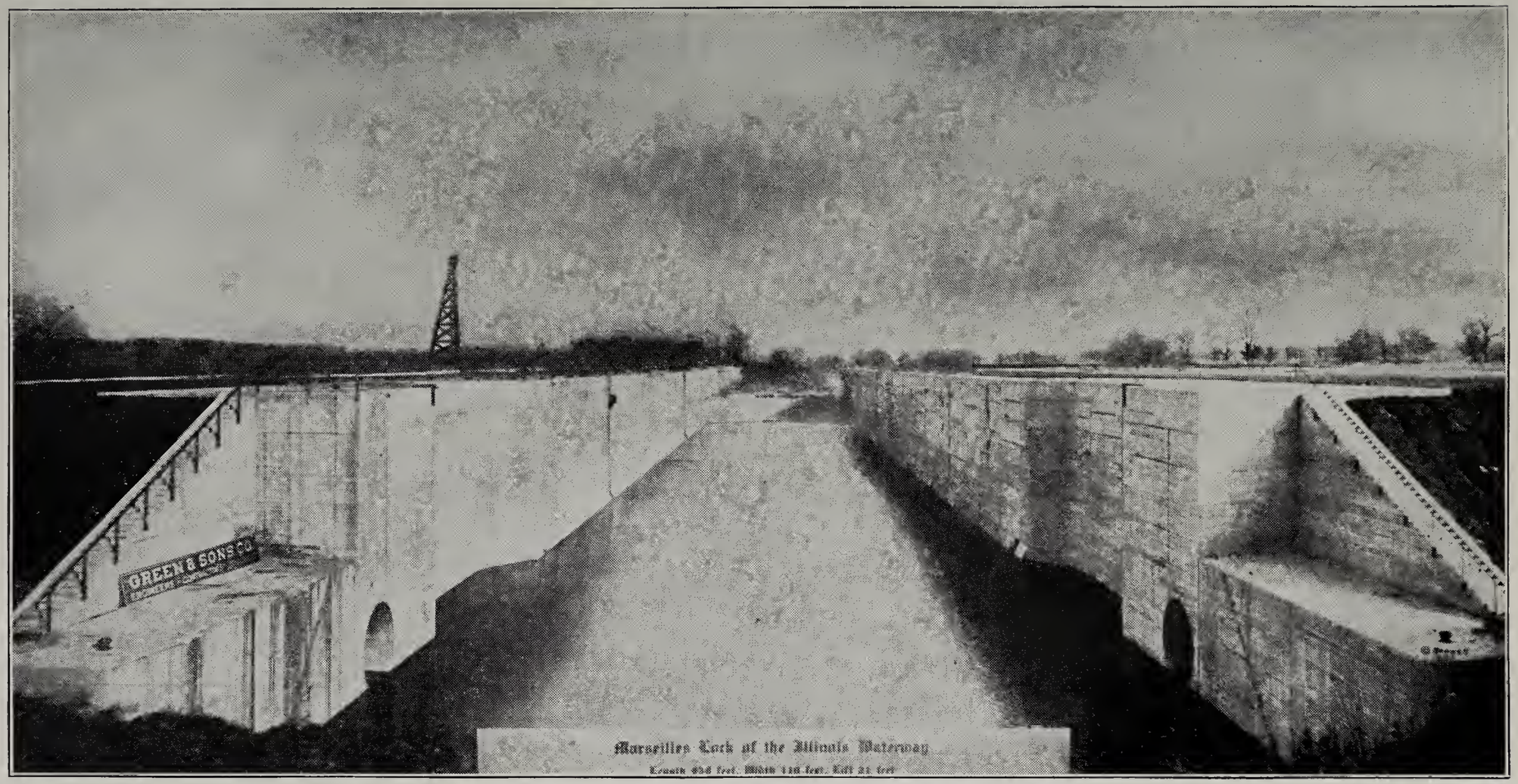
In June of that year the Governor of Illinois applied to the Secretary of War for approval of plans for a waterway having a depth of eight feet and provided with locks having a width of fifty-five feet and a usable length of 300 feet.

After the Engineer Corps had given these plans careful consideration the Secretary of War returned the application to the State in 1916 without his approval.

In 1917 the State adopted its Civil Administrative Code, reorganizing the State Government and established the Division of Waterways. This Division immediately undertook the study of the Lakes to Gulf Waterway, and in November of that year appointed an engineer and took up the studies of the plans for this project with Colonel C. S. Riche, then District Engineer located at Chicago. At that time Congress was considering the "Federal Control Act," contemplating the control and operation of navigation on the lower Mississippi River. That Act became a law March 21, 1918.

Previous to its passage the War Department had constructed a lock in the Mississippi River at Keokuk 110 feet wide and 400 feet long and so designed that its length could readily be extended to 600 feet. The War Department was also in the process of canalizing the Ohio River from Pittsburgh to the mouth of the river with locks 110 feet wide and 600 feet usable length with channel nine feet deep.

Colonel Riche was frequently called in conference with this office and with the Governor of the State. In all those conferences he recommended that the State should design its waterway standard with the improvements then being made in the Ohio River, and that all permanent structures should provide for at least a 9-foot waterway with locks 110 feet wide and 600 feet usable length. The channel should be so designed that it would accommodate fleets that would fill such locks, and preferably should be 500 feet in width. The plans were drawn to meet his views and later informally submitted to the Chief of Engineers for his opinion.



Marseilles Lock, complete except for lock gates and machinery, for which contracts have been awarded. This lock was built for $106,000 less than the estimated cost.

STATE WATER SURVEY DIVISION
WATER SURVEY
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PRESENT ACT, PASSED IN 1919, APPROVED BY SECRETARY OF WAR IN 1920.

After receiving the aid and informal opinion of these officers an Act was drawn to meet their view. After this Act had been submitted to the State Legislature conferences were again held with the Chief of Engineers, who recommended certain minor amendments which were adopted.

The Act as thus drawn was approved by the General Assembly with practically a unanimous vote. Plans were then drawn and officially presented to the Chief of Engineers and Secretary of War, and received the approval of these officers under date of March 6, 1920.

While these negotiations were being carried on the Federal Power Act became a law, and it was necessary for the State to apply to the Federal Power Commission for a preliminary permit for its water power development in connection with the waterway. The preliminary permit the Federal Power Commission received under date of January 14, 1922.

Since the approval of these plans construction work on the locks has been undertaken, the masonry work on the Marseilles lock is completed, the lock at Lockport is 95 per cent completed, and January 29, 1926, the contract for the construction of the lock and dam at Starved Rock was awarded.

CONSTRUCTION COSTS HAVE GREATLY INCREASED SINCE 1908.

Since the passage of the constitutional amendment the cost of labor and materials has increased to such an extent that it will require nearly all of the $20,000,000 for the construction of the deep waterway, and if power is to be developed, it must be through a lease of water rights, or funds for its development must be provided from some other source.

The State's present program shows its greater interest in waterway development, and refutes the charge that Illinois has more interest in the water power than in navigation.

In further substantiation of the position taken by Colonel Riche, and orally expressed to State officers, the views of the officers of the Engineer Corps are shown in official documents. House Document 762, 63rd Congress, 2d Session, page 5, paragraph 5 reads:

"5. The special board considers a bottom width of 160 feet in canal and 200 feet in the open river above the mouth of the Illinois sufficient for a channel of eight or nine feet available depth. For safety and ease of navigation, the channel should be excavated to eleven feet in rock cuts and canals, and the locks should be given eleven feet depth, eighty feet width, and 600 feet usuable length."

That document was written before the experience obtained by the Mississippi Warrior Service was available.

REPORT OF COL. W. V. JUDSON, DISTRICT ENGINEER, IN 1921.

In 1921 after a careful study of the needs of navigation in light of modern traffic conditions, Colonel W. V. Judson, District Engineer in charge of the Illinois River improvement, reported in House Document No. 2, 67th Congress, first session, paragraph 57 and 65 as follows:

"57. For a 9-foot channel, with an increment of 4,167 second-feet, the cost either with dam retained or removed appears almost prohibitive, and the probability that Congress will limit the increment to 4,167 second-feet is, in my opinion, so remote that this hypothesis may be left out of consideration. With increment of 7,500 or 10,000 second-feet the figures show conclusively the advisability of removing all dams. Inasmuch as the Sanitary District of Chicago, and the State of Illinois receive practically all of the benefits that accrue from maintaining the flow of 7,500 second-feet from Lake Michigan, the propriety of the dams being removed at the expense of those interests may well be considered.

"65. In my opinion, to most reasonably conform to the probable conditions of the future, an 8-foot project should now be adopted, based on a 7,500 second-feet withdrawal for purposes of estimate and with all dams removed. Then should Congress place the limit of the amount of water to be withdrawn from Lake Michigan at 10,000 second-feet, which I deem probable and, under proper conditions, advisable, that increment would of

itself increase the depth to 9 feet. The computations show that with all dams removed, an increment of 10,000 second-feet with increase the depths due to the increment of 7,500 second-feet by about 1.25 feet at Utica, about one foot at Peoria and Havana, and slightly less than one foot at the mouth."

These documents and the position of Colonel Riche have indicated that the Engineers of the War Department have felt that the needs of navigation would not be satisfied with anything less than open river navigation on the lower Illinois or with new locks of capacity at least approaching the capacity of those now being constructed in the Illinois Waterway by the State of Illinois.

Respectfully submitted,
(Signed) M. G. Barnes, *Chief Engineer.*

THE DIVISION SEEKS FURTHER MODIFICATION OF U. S. ENGINEER'S REPORT.

These communications secured certain modifications in the report of the District Engineer, but still the report did not satisfy the Division of Waterways. Hence the Chief Engineer of the Division of Waterways was sent to Washington to confer with the Board of Engineers for Rivers and Harbors in an effort to secure further modification of the report. After this conference the following communication was addressed to the Board of Engineers:

STATE OF ILLINOIS
DEPARTMENT OF PURCHASES AND CONSTRUCTION
DIVISION OF WATERWAYS

Leslie Small, Director

CHICAGO OFFICE
950 Transportation Bldg.
Chicago, Illinois

Wm. F. Mulvihill,
Superintendent
M. G. Barnes,
Chief Engineer

May 24, 1926.

Brig. Gen. Edgar Jadwin, Chairman,
Board of Engineers for Rivers and Harbors,
Washington, D. C.

Dear General:

It has been suggested that while in Washington I address your Board relative to the control of the waters of the Great Lakes, which subject you are now studying.

Time is too limited to give this subject proper consideration before your report is due. However, I have given the subject some thought during the past winter, and, therefore, venture to make a few observations based on my somewhat hasty study.

For the past eight or nine years the levels of the Lakes have been lowering, owing largely to climatic conditions. These natural causes have been aggravated by diversions for one cause or another and by improvement of the channels and outlets of the Lakes. Lake Michigan-Huron has reached the lowest point in the history of the Lake Survey Office, and navigation has been restricted as a result.

For more than thirty years the Engineer Corps and civilian engineers have been studying the control of these waters and numerous reports have been made showing that control is possible, yet these waters are allowed to rush on unbridled to the sea. Now that this drainage has become so acute the interests of navigation as well as the riparian interests bordering these Lakes demand some kind of control so that Lake Michigan-Huron and Lake Erie shall be held within reasonable limits.

DISCUSSES COMPENSATORY WORKS AND WATER DIVERSION.

This question resolves itself into two problems—first, compensating for existing and prospective diversions; and second, control to prevent undue lowering of these Lakes during such dry period as we are now experiencing.

The first problem is an elementary one in hydraulics, practiced by everyone from boyhood days. The application of the principles of this problem to these large bodies of water seems as elementary and as easy of solution as the problem would be if applied to small streams and lakes.

The problem was very clearly set forth by Major (now Colonel) C. Keller, Corps of Engineers, on August 13, 1913, in House Document No. 762, 63rd Congress, 2nd Session, page 23. Col. Keller presents this problem in such a clear way that there is little room for debate.

While Col. Keller was dealing specifically with Lake Erie and Lake Huron, the principles are just as applicable to the St. Lawrence River. The St. Lawrence is made up of series of pools and rapids improved for navigation by the Canadian Government. These pools at the heads of the various Canadian canals are affected somewhat by the diversion of water from the Great Lake system at Chicago. The lowering of these pools can be readily restored by the contraction of the discharge channels at the heads of the rapids and at moderate cost. As proof of this, if indeed proof is necessary, the elevation of the water surface of Lake Ontario has been raised by the construction of a dam across the Gut Channel at Galops Rapids, which has raised the elevation of Lake Ontario at least equal to the lowering caused by the diversion at Chicago.

QUOTES FROM REPORT BY COL. KELLER.

To compensate for the lowering of Lake Erie caused by the diversion at Chicago Col. Keller says:

"Weirs and contraction works may safely be built in the portion of the Niagara River at the foot of Squaw Island, near Austin Street, shown on plate 7, and computations show that to produce a rise of 0.45 foot on Lake Erie, the rise at Squaw Island must be 0.85 foot. Three weirs, one at the foot of Squaw Island, and others half a mile above and below, respectively, and averaging 4.2 feet in height above the present river bed, will produce the desired rise of 0.85 foot at Squaw Island, and will thereby compensate for the diminished levels of Lake Erie. With a top width of six feet and side slopes of three horizontal to one vertical, these three weirs would contain about 15,000 cubic yards of material, and if built of solid masonry, at $10.00 per yard, would cost $150,000.00."

Col. Keller finds that with a diversion of 10,000 second-feet at Chicago Lake Michigan-Huron would be lowered 0.47 foot and that the backwater effect of the weir he proposes in the Niagara River would reduce this lowering in Michigan-Huron to 0.31 foot. To overcome this lowering Col. Keller says:

"The average depth of the St. Clair River for a considerable distance below the mouth of the Black River at Pt. Huron is thirty feet, and six weirs may be built below that point, at distances averaging half a mile apart, which will raise the surface of Lakes Michigan and Huron the desired amount and will not reduce the depth over the weirs and elsewhere below twenty-four to twenty-five feet. The mean velocity of the current in this vicinity would be increased from about 3.28 feet to about 3.89 feet per second, or to about two and two-thirds miles perhour, and the effect of this increase would be felt over a distance of about three miles below the upper weir, while above it the river slopes, and velocities, now excessive, will be dimnished and navigation will be benefited. The weirs, located as above, should have a height of about five to six feet above the river bed, and six weirs would require about 65,000 cubic yards of stone, which, at $5.00 per cubic yard, will cost about $325,000.00."

Col. Keller was quite definite in the solution of this problem, fixing the location of his weirs and giving their cubical contents and cost per yard, so that the cost can readily be computed as conditions change by assigning any other unit of cost to the project works.

ALSO THE RREPORT BY COL. J. G. WARREN.

When this problem was again studied by Col. J. G. Warren and reported by him in 1920, we find in comments on Col. Keller's report the following quotation relative to his recommendations and estimates:

"That this method of compensation is practicable and that the desired results can be obtained at a comparatively reasonable cost is beyond question. Furthermore, structures of this nature would offer a minimum of interference with navigation and would have little tendency to retard the movement of ice."

We, therefore, find these two engineers in accord as to the proper method of compensating for present diversions.

Col. Warren, in his report, also dealt with prospective diversions for power, canal and sanitary purposes, the total quantity and effects of which are shown on pages 89 and 90 of his report. As to future diversions he has treated with an increase of diversion at Chicago to 14,000 second-feet and an increased diversion at Niagara Falls amounting to 48,000 second-feet. With this total diversion he finds that Lake Erie will be lowered 1.27 feet. On page 381 of his report will be found remedy for controlling the Niagara River because of power diversion without cost to the Federal Government except for inspection duties.

ESTIMATED COST OF COMPENSATING AND REGULATING WORKS.

To overcome the lowering of the level of Lake Erie because of the large future diversions used in his report he suggests a method similar to that used by Col. Keller and finds that the entire lowering can be overcome by the installation of weirs near Squaw Island, the cubic contents of which amount to 185,000 yards and the cost of their installation he estimates to be $2,000,000.

Col. Warren finds that some additional work of dredging must be done in Lake St. Clair amounting to 800,000 cubic yards at a cost of $160,000. He also estimates that dreding must be done in the St. Clair River, which he estimates "would not cost more than $50,000."

To raise Lake Huron to the required elevation to compensate for the Chicago Diversion (14,000 c. f. s.), Col. Warren suggests "a series of submerged weirs with crest 25 feet below water would serve the purposes."

It is estimated that eleven sets of weirs, placed about one-third of a mile apart, and containing a total of 290,000 cubic yards of stone, will raise the level of the river above the upper weir an amount sufficient to back up Lake Huron to the full amount required. Bank protection would be required at the ends of the weirs—the total cost would probably not exceed $1,500,000.

Summing up his findings, we have:

Niagara River—compensated by Power Companies without cost to the United States.

Lake Erie—compensating works, 185,000 cubic yards	$2,000,000
Lake St. Clair—dredged, 800,000 cubic yards	160,000
St. Clair River—dredged	50,000
Lake Huron—compensating works, 290,000 cubic yards	1,500,000
Total Cost to compensate for present and proposed diversion of 120,785 c. f. s.	$3,710,000

NO SUCH DIVERSION IS NOW TAKING PLACE.

No such diversion is now taking place, and so far as diversion from Lakes Michigan and Huron is concerned, there appears at this time to be little, or no, reason to anticipate a diversion much in excess of what is now being diverted at Chicago; hence the quantities and cost found by Col. Warren are in excess of present requirements.

There seems little doubt but that works of this nature will satisfactorily compensate for all diversions. There may be an honest difference of opinion among engineers as to the exact location of these weirs and their effectiveness; but if the weirs suggested are not sufficient, others could be added

that would completely overcome any lowering that may be caused from diversion. If, on the other hand, the weirs are found to be more than needed, it is an easy matter to remove the excess material.

While this treatment satisfactorily solves the question of compensation for existing diversions, there still remains unsolved the control of the discharge of these lakes due to climatic changes. Apparently that can best be solved by works requiring artificial manipulation, or in other words, by controlling works somewhat similar to those installed at Sault Ste. Marie.

ST. CLAIR RIVER CHANNEL CAPACITY EXCEEDS NAVIGATION NEEDS.

The greatest damage done to shipping interests during the present dry spell has been caused by the excessive lowering of Lake Michigan-Huron through the discharge of its impounded waters through a channel of capacity exceeding that necessary to discharge the decreased run-off from its catchment area. To overcome this, and not unduly raise the lake level during normal rainfall periods, some controlling works are necessary.

First: Such controlling works should contain essentially a navigable pass of sufficient capacity to discharge the natural low water run-off, and,

Second: A series of gates closing a portion of the channel, which gates may be removed during periods of more plentiful rainfall.

To accomplish this purpose, it is suggested that controlling works be installed opposite Stag Island in the St. Clair River, a few miles below Port Huron and extending if necessary to St. Clair. Such controlling works should have a navigable pass of approximately 600 feet bottom width and a depth of thirty feet. The length of this pass is determined by its discharge capacity and its effect upon the elevation of Lake Huron.

HOW LAKE HURON ELEVATION COULD BE CORRECTED.

For the purpose of this study computations have been made for a pass, six miles in length and with a current velocity of three and one-half miles per hour. This study shows that the river will be raised about seven-tenths foot per mile of pass, and that for the full six miles Lake Huron would be raised 2.2 feet at the present low water period—or, more exactly, Lake Huron would have been restrained that amount during the present low water period.

This effect is based on no compensation of Lake Erie, and in all probability the pass is longer than the needs may require. It is, therefore, suggested that for the present, one-half of the length of this pass would be sufficient for present needs; and if and when conditions may require, this pass may be extended downstream to meet the conditions then arising.

The balance of the channel should be spanned by movable gates, located at some convenient point outside of the pass, and so designed that they may be removed from the channel at will. The channel above and below these controlling gates must be enlarged sufficiently to permit a free discharge of all surplus waters without unduly raising the lake levels. The velocity of the current through the pass, and in turn its slope and head created, may be readily controlled by proper manipulation of the gates. The effect of the embankment along the navigable pass may be controlled by its location and design. In the interest of experimentation and observation a shorter pass may be installed than herein outlined.

COST AND BENEFITS OF ST. CLAIR PROJECT.

While no careful estimate has been made of the cost of these controlling works, experience in the construction of the Illinois Waterway indicates that the gates would not cost to exceed $1,200.00 per linear foot, and for a length of about 2,000 feet, the total cost of the gates should not exceed $2,500,000.00. The navigable pass might cost about $650,000 per mile—or for three miles, say $2,000,000.00. There is an additional item of cost that might be found necessary if the increased velocity of this pass should create scour of the river bed. It would be necessary to install sills of heavier material to restrain this erosion. It is believed that $500,000 is entirely sufficient to meet such cost. The total cost of the controlling works would be, therefore, approximately $5,000,000.

The benefits claimed for this project are:

First: Action is positive and may be changed at will by manipulation of the movable gates.

Second: Prevents undue drainage of Lake Michigan-Huron during periods of excessive drought.

Third: The results of thus restraining the discharge of Lake Huron benefits navigation in the St. Mary's River and in the harbors around the lake.

Fourth: If the channel above and below the controlling gates is enlarged, the controlling works may be so manipulated during normal periods of rainfall that an excess of water may be discharged during the last half of each year and a corresponding amount restrained during the first half of the year in aid to nature in the action of ice at the outlet of Lake Huron.

Fifth: Better use of the waters for power and navigation.

Sixth: Compensation works will not prevent drainage of Lakes due to climatic changes improvement of channels, or erosion. Regulation works will.

VARIOUS OBJECTIONS TO PROPOSED PLAN DISCUSSED.

Such manipulation would have the effect of increasing the low water stage in Lake Erie during the early months of the year and decreasing the high water stage during the later months. Inasmuch as the surface area of Lake Michigan-Huron is about four and one-half times the surface area of Lake Erie this manipulation would have little effect on Lake Michigan-Huron, while it would have quite material effect on Lake Erie. The annual means of both lakes would remain unchanged, except that during periods such as we are now experiencing the elevation of Lake Erie would be reduced if the full restraining effect of the regulating works is put in effect, but Lake Erie can be very cheaply compensated as found by the report above cited.

Some objection may be urged against the navigable pass, because it increases the current velocity through that reach of the river in which it is installed. It is believed this is not a serious objection. The velocity in the St. Clair River at the outlet of Lake Huron is about five miles per hour (see Bulletin No. 35, Survey of Northern and Northwestern Lakes, Pages 303) and will be reduced by this construction. The Limekiln Crossing, in a rock section, has a maximum velocity of six miles per hour and a mean velocity of three miles per hour.

Probably the most serious objection from a navigation standpoint is the permanent closing of one channel, and even this might be overcome by a proper design of the gates so that some might be left open for down bound vessels during rush seasons of navigation.

NIAGARA RIVER INSTALLATIONS TO PROTECT LAKE ERIE DEPTHS.

As Lake Erie can be compensated by submerged weirs, as indicated by Col. Keller and Col. Warren, could not it also be safely and cheaply regulated by the installation of some form of movable or collapsible gates, installed on the crest of their weirs, that could be removed during high water periods or during periods in which ice jams are likely to cause damage? It is believed that the installation of such gates is feasible and practicable, or, if preferred, a trailing breakwater, such as is proposed in the St. Clair River, could be safely installed near the head of the Niagara River.

SUMMARY.

1. The only diversion that affects the waters below Niagara Falls is the diversion at Chicago.

2. Compensating works have already been installed at Galop Rapids fully restoring the elevation of Lake Ontario. Authority—Col. J. G. Warren.

3. The effect of Chicago diversion on navigation along the St. Lawrence above Montreal is of minor importance and can readily be compensated at low cost. Authority—Col. J. G. Warren.

4. Lake Erie can be compensated for present diversion by construction of weirs near head of Niagara River at cost of $150,000. Authority—Col. C. Keller.

5. Lake Michigan-Huron can be compensated for present diversion by construction of weirs in St. Clair River below Port Huron at a cost of $325,000. Authority—Col. C. Keller.

6. Niagara River can be compensated for present and future diversion amounting to 120,785 c. f. s. by contracting the channel of the river with spoil from Power Canals at no cost to the United States other than inspection costs. Authority—Col. J. G. Warren.

7. Lake Erie can be compensated for same diversion by installing weirs near head of Niagara River at cost of $2,000,000.00. Authority—Col. J. G. Warren.

8. Lake St. Clair, the St. Clair River and Lake Michigan-Huron can be compensated for this same diversion by dredging and weirs at a cost of $1,710,000. Authority—Col. J. G. Warren.

9. Both Lake Erie and Lake Michigan-Huron can be regulated against present and future diversions at a cost probably not in excess of eight to ten million dollars, and possibly well within the lower figure.

10. There seems to be no insurmountable difficulties preventing the installation and trial of regulating works.

11. Regulation prevents drainage of lakes, Compensation will not.

If this solution of the control of the levels of these lakes interests you, I will be glad to confer with you and other members of your board while in Washington, or take the matter up with you in any other manner that will meet your convenience and approval.

Very respectfully,

(Signed) M. G. Barnes,
Chief Engineer."

U. S. CHIEF OF ENGINEER'S REPORT BRINGS SOME CHEER TO MID-WEST.

This conference requested a further modification of the report as finally presented to the Chief of Engineers by the Board.

The report still recommends the retention of the old locks, which are seventy-five feet wide and 350 long. If these locks are to be retained permanently, it will limit the capacity of the Illinois Waterway to 31 per cent of the capacity of the locks being built by the State, and will add greatly to the cost of navigation, as shown by letters above quoted.

However, the Chief of Engineers made his report on this resolution in House Document No. 4, Sixty-ninth Congress, first session, recommending the improvement of the river to a depth of nine feet and a channel width of 200 feet at a cost of $1,350,000.00 based on the present flow from Lake Michigan, i. e., 8,250 c. f. s. This recommendation contemplated the removal of portions of the present State dams at Henry and Copperas Creek, and the retention and modification of the present federal locks and dams at LaGrange and Kampsville.

FAVORS 9-FOOT CHANNEL WITH REMOVAL OF STATE DAMS IN LOWER ILLINOIS.

A part of the Chief of Engineer's report is in the following language:

"14. The board therefore recommends modification of the existing project for the Illinois River to provide a channel with least dimensions of nine feet in depth and 200 feet in width from the mouth to Utica, by dredging and by the partial removal of the two State dams and the retention and minor alteration of the two Federal locks and dams, at an estimated cost under present conditions of diversion of $1,350,000, with $126,000 an-

nually for operation and maintenance; *provided*, that the State of Illinois transfers to the United States without cost all rights and titles in the two State-owned dams on the Illinois River; that local interests furnish the United States without cost all necessary areas for the economical disposal of material dredged in creating and maintaining the channel; *provided, further*, that no work on the Illinois River shall be carried out according to the project herein outlined, with the existing or any subsequent diversions, until the Secretary of War and the Chief of Engineers shall have received satisfactory assurances that local interests will provide an equal depth for through navigation in the Illinois Waterway. The amount of $1,350,000 should be made available in the initial appropriation. With any future reduction in the diversion a reestimate of the cost of completing or revising and maintaining the project will become necessary. If after the completion of the Illinois waterway several years hence the large commerce expected has developed in such a way that the Federal locks are becoming inadequqate for the navigation, consideration should at that time be given to the relative desirability of the partial removal of the dams or the provision of increased lock capacity, as may then appear best.

NO RECOMMENDATION AS TO FINAL FIGURE ON DIVERSION.

"15. The board states that the position of the War Department in the matter of the diversion at Chicago is set forth in the documents connected with the issue of the permit of March 3, 1925, namely, that every effort should be made to restrict the amount of diverted water. The board, in its present report, is concerned primarily with providing an immediately workable scheme of navigation in the Illinois River, and hence has based its estimates on the actual existing diversion, which, as explained in paragraph 26, is approximately 8,250 cubic feet per second. It invites attention to the fact that it does not recommend this as the final figure; the work it proposes will be useful in any future project that may be based on a lesser diversion. As indicated in paragraph 20 of the board's report there are many facts which have a bearing on the matter of the amount of diversion, among these being the successful and economical operation of the immensely important commerce of the Lakes, whose magnitude and benefits far exceed those of any probable commerce now foreseen on the Illinois River and Waterway. It has been shown by the present investigation that the amount of the diversion is not a governing factor in providing a 9-foot channel on the Illinois, as the amount can be varied within wide limits and still leave such a channel entirely practicable, though its cost would be increased as the diversion decreases. The problems in question are in process of investigation and it is hoped of orderly settlement. For the present, therefore, the board does not recommend that any final figure for the diversion should be set; nor that any change be now made in the policy with respect to the proper ultimate diversion.

"16. After due consideration of the above-mentioned reports I concur in the views and recommendations of the board.

Very truly yours,
(Signed) H. TAYLOR,
Major General, Chief of Engineers."

EXTENDED HEARINGS BEFORE HOUSE COMMITTEE ON RIVERS AND HARBORS.

Upon receipt of this report the Committee on Rivers and Harbors held a series of hearings, at which unmerited opposition from the States of Ohio, Michigan and Wisconsin developed. The State administration was represented in all these hearings by the Chief Engineer of the Division of Waterways, covering a period of nearly four months.

The State of Illinois had three representatives on the River and Harbor Committee, namely, Congressmen M. Alfred Michaelson and Stanley H. Kunz from Chicago, and William E. Hull of Peoria. Dur-

ing these hearings Congressman Martin B. Madden and Henry T. Rainey also appeared in the interests of the State of Illinois.

The opposition to the Illinois item in the River and Harbor bill was based on alleged damage to navigation, damage to power interests along the Niagara and St. Lawrence Rivers, and damage to riparian rights along the lake shores. The representatives from the State of Illinois explained the recommendations of the Chief of Engineers, and were able to show that diversion from Lake Michigan was not contemplated by the report of the Chief of Engineers. He had simply recommended a modification of the existing seven-foot project in the Illinois River below Utica adopted in 1880 and not yet completed, to a nine-foot project depth with the water found in the Illinois River as diverted from Lake Michigan for sanitary purposes. The provisions of the Chief of Engineer's report required that this project depth should be maintained at whatever diversion from Lake Michigan existed, and if or when the present diversion is decreased, further excavation should be made in the Illinois River to maintain the channel depth.

OHIO, MICHIGAN AND WISCONSIN OPPOSE ILLINOIS RIVER IMPROVEMENT.

Still the lake states above mentioned continued their opposition to the provisions of the bill. Extravagant and exaggerated statements were made, showing alleged damages as result of the diversion from Lake Michigan for sanitary purposes in what appeared to be an effort to divert attention from navigation interests to sanitation, which was not an issue before the Congress. After the hearings were completed the committee reported a River and Harbor Bill, which included an item for the improvement of the Illinois River in accordance with the report of the Chief of Engineers in the following language:

"Illinois River, Illinois, in acordance with the report submitted in Rivers and Harbors Committee Document Numbered 4, Sixty-ninth Congress, first session, and subject to the conditions set forth in said document."

OPPOSITION BY LAKE STATES CONTINUES DESPITE AMENDMENT TO BILL.

These hearing consumed so much time that the River and Harbor Committee lost its calendar day and a special rule was required to get consideration on the floor of the House for the River and Harbor bill. This required consideration by the Rules Committee and before favorable action by that committee was taken it was necessary to amend the River and Harbor Bill in an effort to assure Congress that no question of diversion was involved and accordingly the bill was amended to read as follows:

"Illinois River, Illinois, in accordance with the report submitted in Rivers and Harbors Committee Document Numbered 4, Sixty-ninth Congress, first session, and subject to the conditions set forth in said document: *Provided*, nothing in this Act shall operate to change the existing status of diversion from Lake Michigan, or change in any way the terms of the permit issued to the Sanitary District of Chicago March 3, 1925, by the Secretary of War, but the whole question of diversion from Lake Michigan, for sanitation, navigation, or any other purpose whatsoever, shall remain and be unaffected hereby as if this Act had not been passed."

After this amendment a rule was obtained permitting the River and Harbor Committee to report the bill to the House under a twelve hour debate.

HOUSE PASSES RIVERS AND HARBORS BILL 219 TO 127.

Even with the item amended the most bitter opposition and filibuster followed. Under the leadership of Congressman Madden the entire Illinois delegation assisted in the passage of the bill by the House. Every Congressman from Illinois voted for the bill, with the exception of Charles E. Fuller, who was absent on account of illness and who later passed away before Congress adjourned. The final vote on the passage of this bill by the House stood 219 for and 127 against.

The bill then went to the Senate and to the Committee on Commerce for consideration. The Commerce Committee held hearings on the bill covering nearly two weeks, most of the time being consumed in consideration of the Illinois River improvement item. During these hearings the same opposition developed that had appeared before the House committee and the same reasons for the opposition were advanced except that nothing was said about damage to power interests. The opposition before the Commerce committee was aimed largely at alleged damage to navigation interests, charged against the Chicago diversion.

FACTS ESTABLISHED BEFORE SENATE COMMERCE COMMITTEE.

The elevation of the water surface of Lake Huron and Lake Michigan has been lowering for the past eight or nine years of continued and unprecedented drouth in the region of the Great Lakes. The elevation of these two lakes during the past winter has been the lowest on record.

The uninformed observer, not understanding the physical conditions, and reading propaganda put out by certain interests is liable to be misled and to believe that the entire lowering of the lake levels is caused by the diversion at Chicago. This claim was voiced strongly before the Commerce Committee of the Senate.

The friends of the Illinois River project were able to prove from government records and documents that the diversion at Chicago is responsible for only 4½ inches of the total lowering of these lakes which amounts to upwards of three feet, and that little or no damage to navigation has resulted from the Chicago diversion. It was also shown that the damage, if any, that navigation interests were suffering, was a result of the continued unprecedented drouth plus the improvement in the St. Mary's River for navigation purposes, which improvement had resulted in the lowering of the water at the Soo locks upwards of thirteen inches. At the beginning of this year's navigation season Lake Huron and Lake Michigan were about eighteen inches below their low water datum plane, due principally to dry weather conditions. This eighteen inches plus the thirteen inches lowering of the water at the Soo locks decreased the depth to which vessels could load by thirty inches.

EXCAVATION IN ST. CLAIR AND DETROIT RIVERS LOWER LAKES.

It is also pointed out that lake survey records indicate that the excavation in the St. Clair and Detroit Rivers has increased the capacity of these streams for the discharge of the waters of Lake Huron

to such an extent that the difference in elevation between Lake Huron and Lake Erie had progressively decreased since the alterations of these channels made in the interest of navigation.

While no data were available at that time to prove that these streams had a larger capacity owing to the improvements, yet government records indicated that the rivers were carrying greater quantity of water due to these improvements and indicated that further studies should be carried on by Federal engineers to determine the cause of this decreased fall between Lake Huron and Lake Erie, and to apply the remedy.

Attention was called to the fact that by order of the Secretary of War, Chicago had on deposit $1,000,000.00 in the treasury at Washington to pay for the installation of remedial works on the Great Lakes, which works would raise the elevation of the lakes sufficient to compensate for any diversion at Chicago, and that various engineering reports had been made by the War Department indicating that this sum was entirely sufficient to overcome any damage and lowering of the Great Lakes due to the Chicago diversion. Still the opposition persisted.

AMENDED BILL MADE SPECIAL ORDER IN U. S. SENATE FOR DECEMBER 14, 1926.

After the hearings were completed the Commerce Committee considered the bill in executive session, and amended the Illinois River improvement item to read as follows:

"Illinois River modification of existing project so as to provide a channel of least dimension of nine feet in depth and 200 feet in width from mouth to Utica; *provided*, that the State of Illinois transfers to the United States without cost all right and title in the two State owned dams in the Illinois River; and that local interests furnish the United States without cost all necessary areas for the economical disposal of material dredged in creating and maintaining the channel herein and hereby authorized; *provided further*, that there is hereby authorized to be appropriated for the project a sum not to exceed $3,500,000."

The bill was then submitted to the Senate for passage. Even this reading of the Illinois River item did not satisfy opponents to the bill and the filibuster continued. It then became evident that the opposition came from some other cause than alleged damage to navigation interests because of lowering of the lake levels. A continued filibuster was threatened, led by Senator Willis of Ohio. It was now the last of June and the Senators were very anxious to adjourn, having practically completed the balance of their legislative duties for the first session. Hence, in order to secure proper consideration of the bill, and to avoid the loss of time, conference was held among the leaders in the Senate, as a result of which the River and Harbor Bill was made a special order for consideration on December 14 next, at which time the bill will be debated on the floor of the Senate, and the debate and consideration of the bill continued until action has been taken unless by unanimous vote consideration is suspended.

This action of the Senate seems to make it certain that the bill will be acted upon before the army appropriation bill by this Congress,

and no time will be lost in the improvement of the Illinois River project if the bill passes the Senate and the present indications are that it will pass by a safe majority.

DIVISION OF WATERWAYS PUBLICITY.

During the fiscal year, as authorized by law, the division has issued special bulletins dealing with local, state and national aspects of its work as follows:

"CALUMET HARBOR," "SANITARY DISTRICT LAND SALES," "FIXED BRIDGES."

Bulletin No. 26, issued in January, 1926, deals with questions affecting the development of terminal facilities in Chicago and includes a discussion of "Calumet Lake and the Chicago-Nickel Plate Agreement," "State Supervision of Chicago Sanitary District Land Sales," and "The Policy of Fixed Bridges over the Chicago River." This 30-page bulletin contains a synopsis of the State law as to Lake Calumet Harbor; a copy of the conditional permit and approval of the plan, issued by the State in 1922; a copy of the city's application for transfer of harbor lands to the Nickel Plate railroad; report of our engineer department regarding the plan as submitted, with an analysis of the proposed agreement and observations as to importance of comprehensive terminal plans; copy of a letter from the Superintendent of Waterways to the city of Chicago listing seventeen reasons for declining to recommend to the Director the requested approval of the City-Nickel Plate Agreement.

COMPILATION OF STATUTES DEFINING JURISDICTION OF DEPARTMENT.

Bulletin No. 27, issued in February, 1926, is a 24-page compilation of the laws of the State with reference to the powers, duties and jurisdiction of the Department of Purchases and Construction, Division of Waterways, to construct, operate and maintain the Illinois Waterway; to control and manage the Illinois and Michigan canal properties; and to prevent pollution of or encroachment upon any waters of the State.

NATIONAL ASPECTS OF LAKES-TO-GULF WATERWAY.

Bulletin No. 28, now in preparation, will discuss the "National Aspects of the Lakes-to-Gulf Waterway and Diversion of Water From Lake Michigan for Navigation Purposes." It will also deal with the question of diversion of water with reference to its importance and relation to the Boundary Waters Treaty of 1909 between the United States and Great Britain. It will print the treaty in full, together with illuminating quotations from the official proceedings before the United States Senate Committee on Foreign Relations, when the terms of the proposed treaty were under discussion.

MAGAZINE AND NEWSPAPER ARTICLES.

During the year I have prepared for publication numerous special articles dealing with the work of the division. These include "The Illinois Waterway, Now Being Built by Governor Small, and What

It Means to Agriculture, Commerce, Industry and All Classes of People," which was prepared for the Illinois Republican Council Bulletin, and of which 1,000,000 copies were printed;

"What the Illinois Waterway Will Mean to Chicago Industry," published in "Chicago Commerce," the official magazine of the Chicago Association of Commerce;

"Making Navigation Dreams Come True," published in the Mississippi Valley Magazine, official organ of the Mississippi Valley Association, showing the progress in building the Illinois Waterway, the "Missing link" between the Lakes and the Gulf;

"The Illinois Waterway Is on Its Way;" "Present Status of the Illinois Waterway," and numerous other articles of similar character printed in various daily and weekly newspapers throughout the State.

PUBLIC MEETINGS AND INSPECTION TOURS.

As Superintendent of Waterways, I have felt it incumbent upon me to accept invitations to address public assemblies and have accordingly made numerous speeches throughout the State upon various subjects within the scope of Division activities.

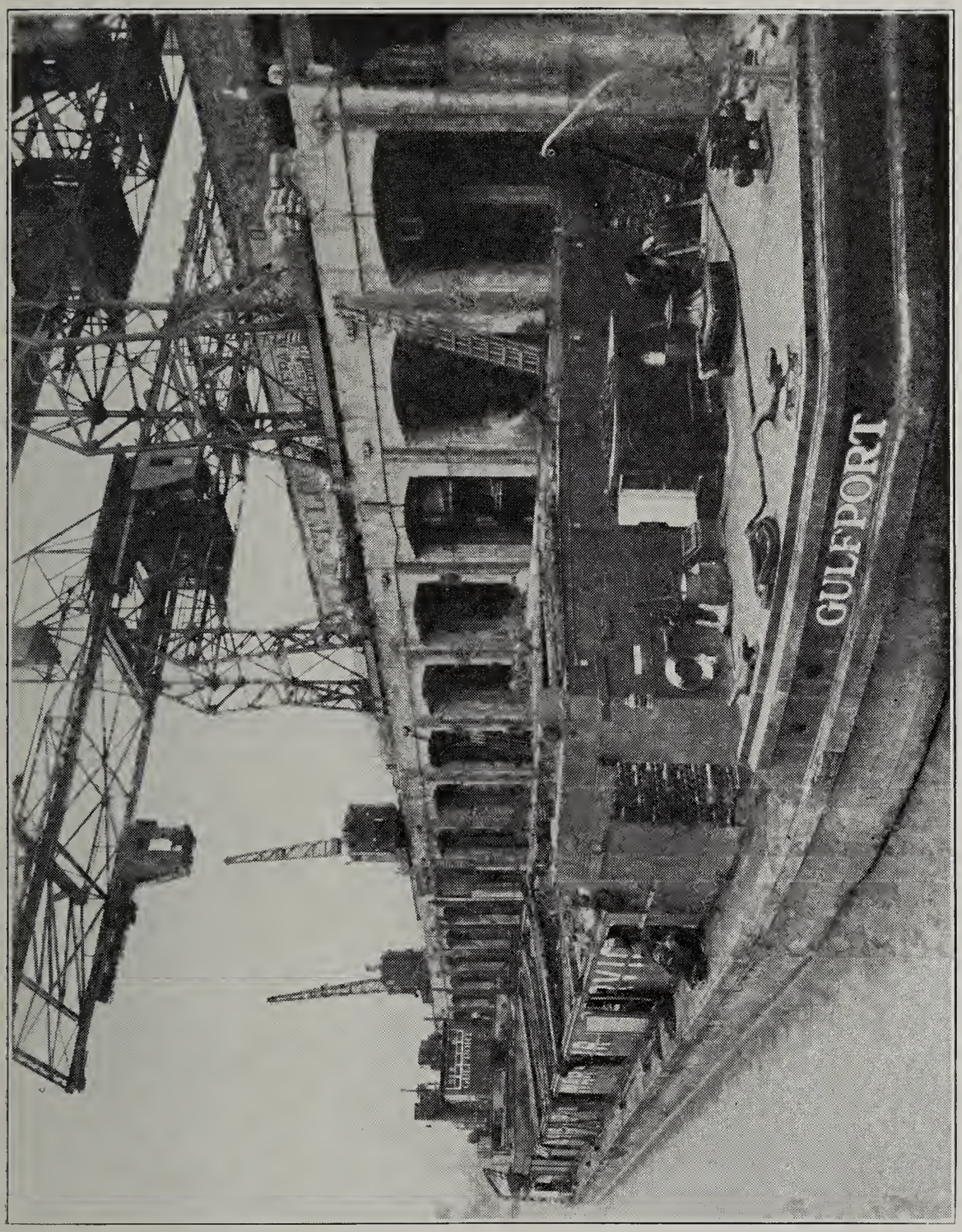
May 19, 20 and 21, 1926, were spent in an "Illinois Waterway Tour," with members of the Illinois Chamber of Commerce, including an inspection of Chicago's lake and river terminals; a boat trip from Chicago to Lockport, with inspection of the construction work on the State lock at that point; a luncheon conference at Joliet, as guests of the Joliet Chamber of Commerce; an interurban special train ride to Starved Rock to view the progress of the State work there, with stops at Morris, Marsielles and Ottawa enroute; dinner meeting at LaSalle with program of speeches; boat trip from LaSalle to Peoria, with stop for luncheon at Henry; dinner meeting at Peoria with a program of speeches.

A similar inspection tour by members of the Chicago Association of Commerce is projected.

"ILLINOIS WATERWAY" RIGHT-OF-WAY.

In the valleys of the DesPlaines and Illinois Rivers the construction of the Illinois Waterway will result in raising the water in the various pools to such heights as will overcome the natural current of the streams. There will be five pools between Lockport and Utica. The total fall in this sixty-five miles in 140 feet and the five locks have a combined lift of 126 feet, thus a "slope" of fourteen feet will provide the downstream current through the sixty-five mile reach of the completed waterway.

The effect of the construction of the required locks and dams will be the overflow, at highwater stage, of nearly 6,000 acres of land lying in the valleys of these two streams. Nearly all of this land has been surveyed and evaluated by the Division of Waterways, and will be taken over by the State as soon as needed, either by negotiated purchase or condemnation proceedings, if necessary. The acquiring of title to the



Type of self-propelled fast boat of the Federal Barge Line on the Mississippi River, at the St. Louis Municipal Wharf.

lands to be flooded is only awaiting the more pressing work of securing title to sites for locks, dams and appurtenant construction.

PUBLIC SERVICE COMPANY OWNS 1,900 ACRES.

Negotiations have been in progress with representatives of the Public Service Company of Northern Illinois since December, 1925, and it is hoped that an early agreement may be reached. This company owns substantially 1,900 acres in the valley of the DesPlaines, including the site of Brandon Road lock and dam, just below Joliet, extending on both sides of the river, all the way down to and below the confluence of the DesPlaines and Kankakee rivers, which unite near Dresden Island to form the Illinois.

This land was acquired by the company when it was believed that the DesPlaines River was non-navigable, in law as well as in fact, and the owners planned to construct a water power plant, at or near the site of the State's proposed Dresden Island lock and dam.

This company also holds title, under a ninety-nine-year lease, to about 300 acres of land at Marsielles, through which it will be necessary for the State to construct a navigable channel to connect the Illinois River, above the present dam of the Marsielles Land and Water Power Company, with the Marsielles lock already constructed at Bell's Island, about two and one-half miles below Marsielles.

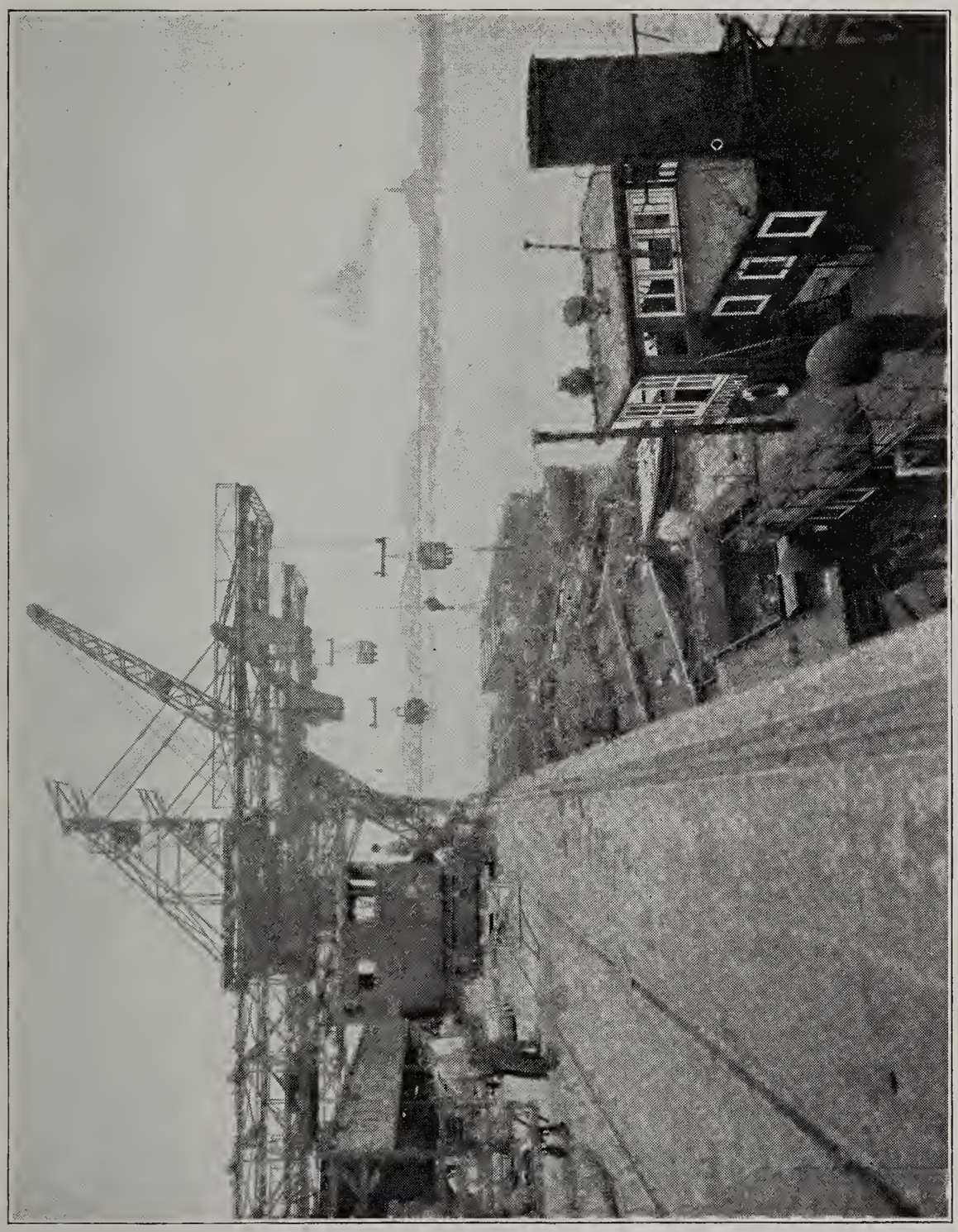
The Superintendent of Waterways has been assured by attorneys for the public service company of an early and amicable settlement of the pending negotiations. When this promise is realized it will make possible the immediate taking of bids for the remaining construction work, and the completion of the Illinois Waterway in a period of from two and one-half to three years. The other lands will be acquired while the work of construction is being completed.

WATER CRAFT AND TERMINALS.

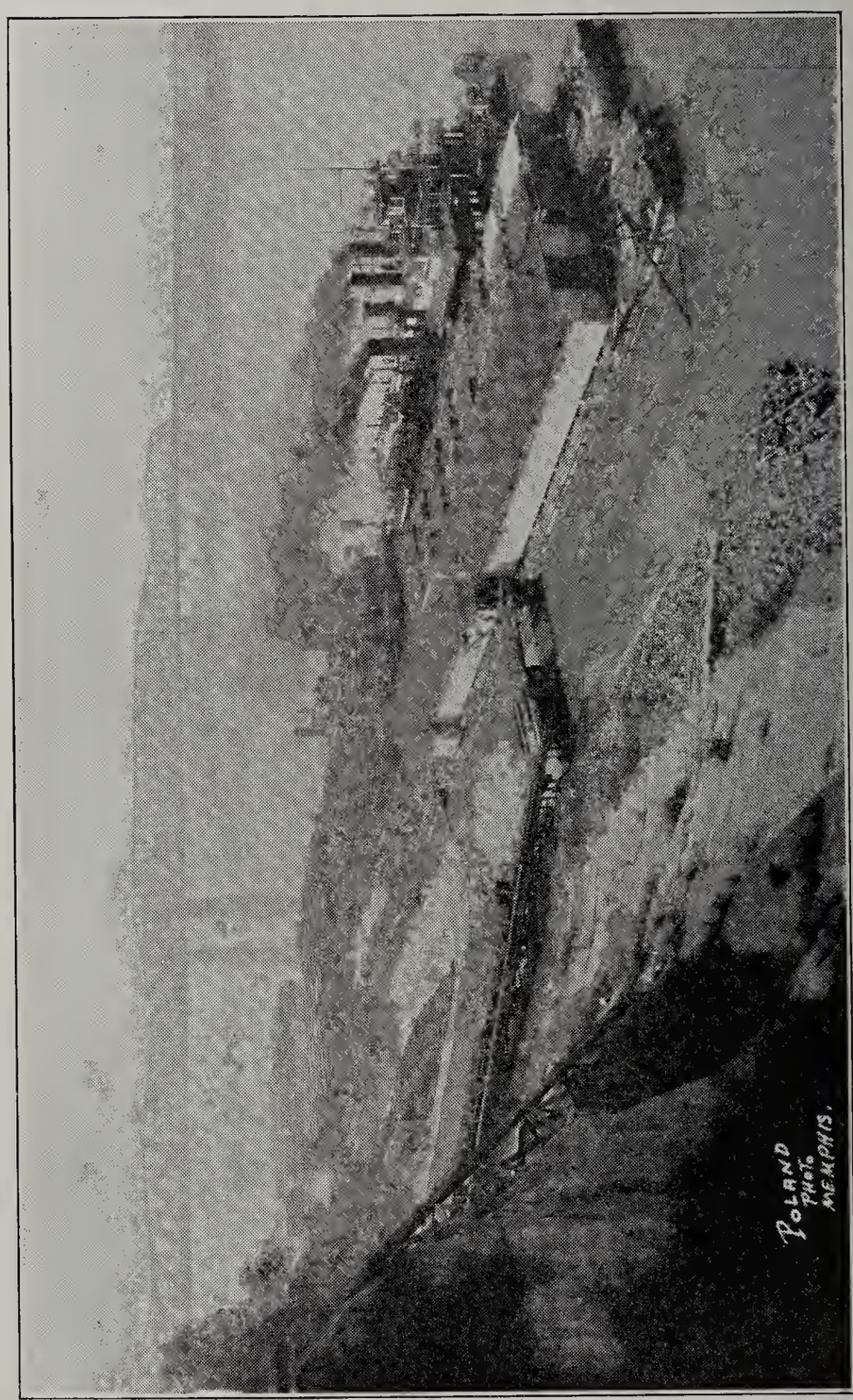
The character of water craft suitable for use on the Illinois Waterway and Mississippi River system is receiving considerable attention from engineers and transportation experts.

It sems to be the general theory that for bulk commodities, to be transported long distances, the larger the carrying capacity of the craft the better; but shipments in quantities less than full barge lots is worthy of consideration.

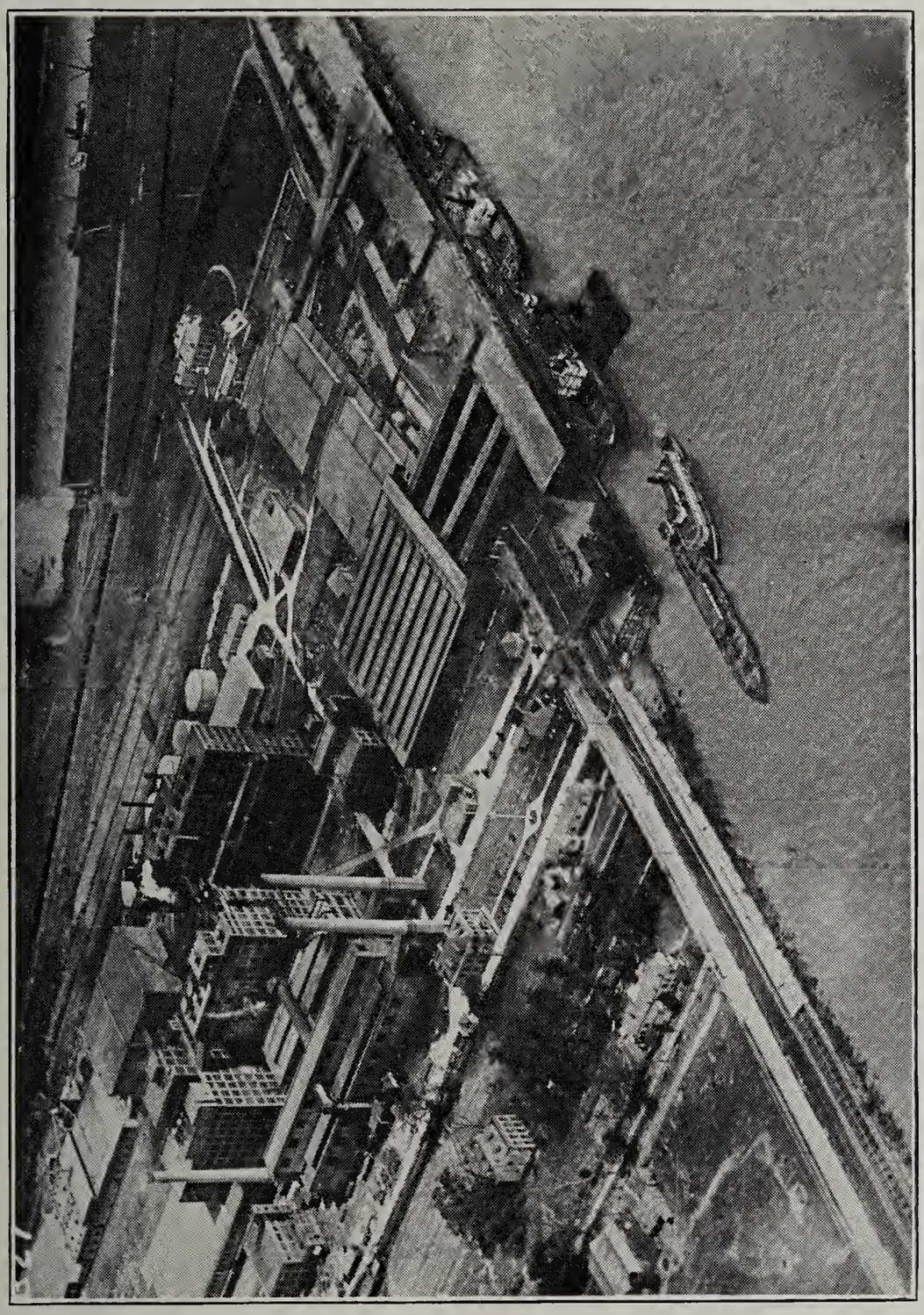
The present standard steel cargo barge of the Federal Government, used in the Mississippi River service, is 230 feet long and 45 feet beam dimensions over all, with a carrying capacity of 2,000 tons each, equal to more than seventy carloads. When loaded to full capacity and to be unloaded at the same destination, this is proving very satisfactory, but for less than barge lots, where delivery has to be made at different ports, the cost due to delay of an entire tow suggests the idea that barges of less capacity that could be detached from the tow and after being unloaded and reloaded could be picked up by the next tow, might be advantageous.



Efficient Waterfront facilities which are among the Terminal assets of St. Louis. (Courtesy Chicago Assn. of Commerce.)



Barges and Municipal River and Railroad Terminals at Memphis. (Courtsey Chicago Assn. of Commerce.)



Waterfront Plant of American Sugar Refinery—largest in the world—at New Orleans. (Courtesy Chicago Assn. of Commerce.)

Standard steel barges upon the upper Ohio and the Monogahela River are twenty-six feet wide by 175 feet feet in length, carrying about 775 tons each when loaded to a draft of seven feet four inches, which is about the maximum economical draft for a channel depth of nine feet. For many purposes barges of this size are desirable when united in fleets, but when being handled light as single units they are said to be somewhat topheavy.

COULD BE USED IN ILLINOIS WATERWAY.

These barges twenty-six fet wide and 175 feet long, when used in tows on the Illinois Waterway, should prove very satisfactory. Ten such barges and a towboat could pass through one of the standard locks of the Illinois Waterway at a single lockage with a minimum use of water for lockage purposes. Four barges abreast would require a width of 104 feet, three barges in length with a power boat partially sandwiched between two barges, would fit snugly into the lock chambers, which are 110 feet wide by 600 feet long. Thus about 8,000 tons of freight would be handled at a single lockage without breaking up the tow.

Another advantage of this width of barge used on the Illinois Waterway is that the distribution in the Chicago District would permit the two-way passage of such barges in tandem formation through the Calumet Sag Channel which is but sixty feet wide and which otherwise would have to be used for one way traffic, since wider barges and the standard barges of the Mississippi service could not pass each other.

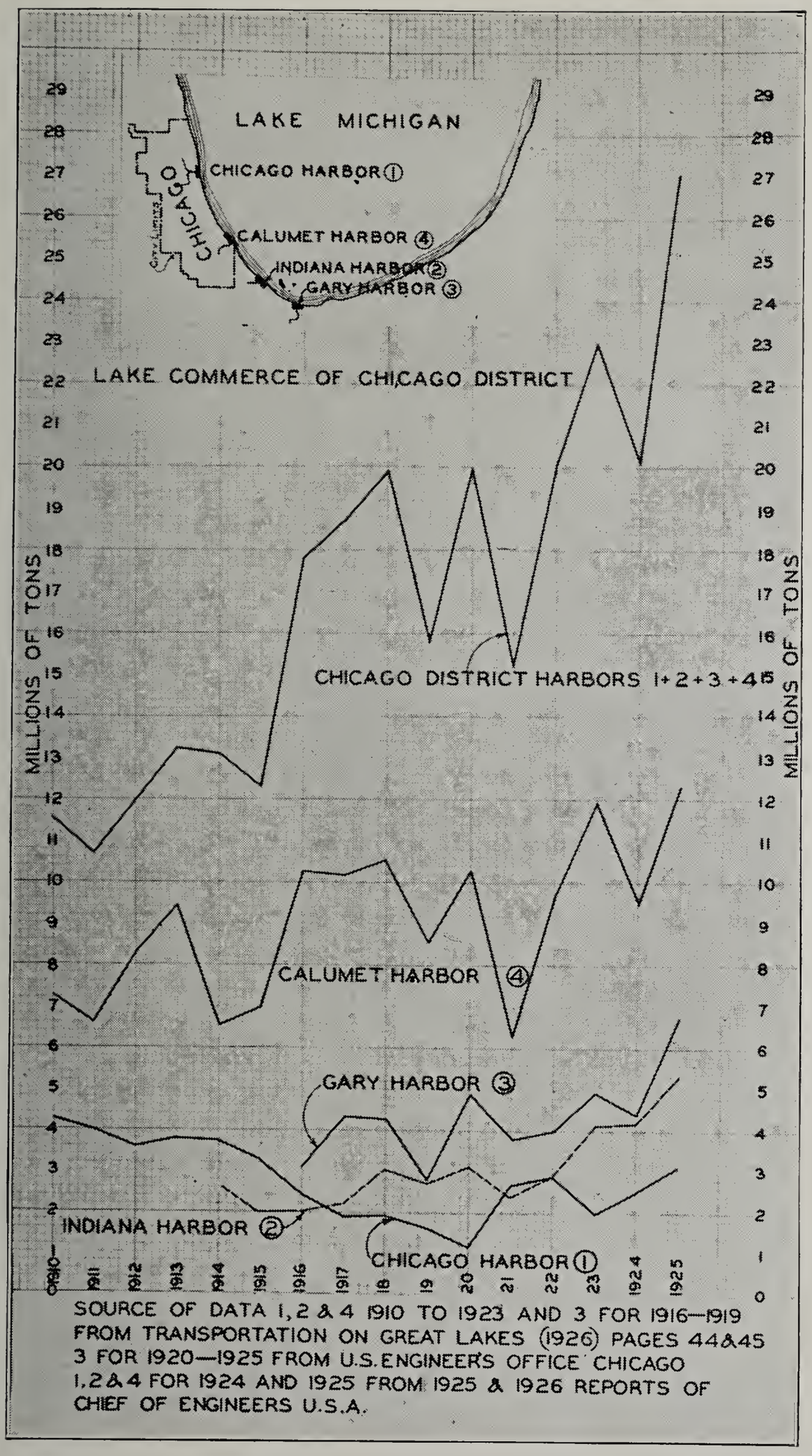
The subejct of proper terminals is of increasing importance and is demanding the attention of private interests and public officials of the cities located on the navigable waters of the Middle West and studies are being made by various municipalities with a view to determining the type of terminals to best suit their respective conditions and requirements.

Chicago will be the most important port of the Illinois Waterway and will require a vast amount of terminal and harbor improvement to care for the barge tonnage which is expected to develop.

While the tonnage of the Chicago Harbor, which includes only the Chicago River and its connecting channels, has fallen off during the past fifteen years, due to a lack of terminal facilities, the tonnage of the Chicago Terminal District has shown a greater rate of increase than any other harbor on the Great Lakes. The plate on page 59 shows the lake tonnage statistics of this district from 1910 to 1925.

RECOMMENDATION FOR PUBLIC PRESERVES.

Section 19 of the Act creating the Rivers and Lakes Commission, the duties and powers of which now devolve upon the Department of Purchases and Construction, Division of Waterways, provides as follows:



SOURCE OF DATA 1, 2 & 4 1910 TO 1923 AND 3 FOR 1916—1919 FROM TRANSPORTATION ON GREAT LAKES (1926) PAGES 44&45
3 FOR 1920—1925 FROM U.S. ENGINEER'S OFFICE CHICAGO
1, 2 & 4 FOR 1924 AND 1925 FROM 1925 & 1926 REPORTS OF CHIEF OF ENGINEERS U.S.A.

PUBLIC PRESERVES OR RESERVATIONS.

"Section 19. It shall be the duty of said Rivers and Lakes Commission to, from time to time, prepare and devise schemes, plans, ways and means for the reservation by the State of desirable tracts of land in connection with the public waters of the State of Illinois, to the end that public reservations or preserves may be made along said public bodies of water for the use of all of the people of the State of Illinois, for pleasure, recreation and sport, and to recommend to the legislature, from time to time, such measures as in their judgment will make effective the plan for the creation of such public reservation, and as such reservations of (or) preserves may be made from time to time, the same shall be under the jurisdiction of the Rivers and Lakes Commission."

(See Section 66, Chap. 19, Smith-Hurd, Illinois Revised Statutes 1925.)

STATE PARK PROPOSED FOR DRESDEN HEIGHTS.

In harmony with this provision of the law, the attention of the General Assembly is called to two proposals:

First, the purchase by the State for a public preserve of land now under private ownership at Dresden Heights, adjacent to the new lock and dam to be constructed at Dresden Island, in the Illinois River.

Second, the acquisition of overflow and waste lands along the Illinois and Mississippi rivers, for the double purpose of affording a public preserve for the natural wild life of the State and of providing possible reservoirs for impounding surplus and flood waters.

OVERLOOKS DESPLAINES, KANKAKEE AND ILLINOIS RIVERS.

Regarding the first proposal, attention is called to the fact that Dresden Heights is of notable scenic beauty, overlooking three rivers, being the point where the Kankakee and DesPlaines Rivers unite to form the Illinois, our largest river, and which gives our State its name.

The accessibility of Dresden Heights as a resting place, "for the use of all the people of the State of Illinois, for pleasure, recreation and sport," coupled with its historic associations and natural beauties, emphasizes its desirability as a public preserve, and I therefore recommend the purchase of the land on both sides of the three rivers, at an estimated cost of not exceeding $100,000, for approximately 500 acres.

ANOTHER SITE FOR PRESERVE OF WILD LIFE.

Regarding the second proposal, it is suggested that an adequate appropriation be made by the next General Assembly to provide for a comprehensive study of the possibilities of flood control—such projected effort to be made in conjunction with the Federal Government—and to report to the succeeding General Assembly its findings and recommendations upon the subject, with special reference to the preservation of the wild life of the State by the creation of such preserve.

ENGINEERING REPORT.

By M. G. Barnes, *Chief Engineer.*

Construction work on the Illinois Waterway has been confined to the Lockport lock and the Starved Rock lock and dam.

The Lockport work is being done by Green & Sons Company, to whom the contract was awarded on October 8, 1923, for the construc-

ILLINOIS WATERWAY.

CONTRACT NO. 6—CANVASS OF BIDS RECEIVED, JAN. 5, 1926. ALL BIDS REJECTED.

Item No.	Item.	Unit.	Quantities.	H. E. Culbertson Co., 1577 Union Trust Bldg., Cleveland, Ohio.		Spencer, White & Prentis Co. of Illinois, Washington Blvd. Bldg., Detroit, Mich.		Henry W. Horst Co., Rock Island, Ill.		Great Lakes Dredge & Dock Co., 104 S. Michigan Ave., Chicago, Ill.		M. E. White Co., 1735 Fullerton Bldg., Chicago, Ill.		L. E. Myers, 53 W. Jackson Blvd., Chicago, Ill.		Shnable & Quinn, 30 N. LaSalle St., Chicago, Ill.		Greiling Bros. Co., Green Bay, Wis.		Green & Sons Co., 6 N. Michigan Ave., Chicago, Ill.		Bates & Rogers Construction Co., 715 Old Colony Bldg., Chicago, Ill.		Average of all bids received.	
				Price.	Amount.	Price.	Amount.	Price.	Amount.	Price.	Amount.	Price.	Amount.	Price.	Amount.	Price.	Amount.	Price.	Amount.	Price.	Amount.	Price.	Amount.	Price.	Amount.
A	Clearing	Lump sum	1		$ 5,000 00		$ 50,000 00		$ 110,000 00		$ 2,112 00		$ 23,000 00		$ 24,000 00		$ 3,000 00		$ 16,000 00		$ 25,500 00		$ 9,680 00		$ 16,927 20
B	Cofferdams, pumping, etc	Lump sum	1		65,000 00		75,000 00		275,750 00		168,555 20		160,790 00		265,700 00		97,000 00		200,000 00		472,000 00		300,000 00		207,979 53
C	Excavation	Cu. yd	202 000	$ 1.35	272,700 00	$ 2.50	505,000 00	$ 2.45	494,900 00	$ 2.951	597,112 00	$ 2.00	404,000 00	$ 2 87	565,600 00	$ 2 50	505,000 00	$ 2 75	555,500 00	$ 3 30	666,600 00	$ 3 75	757,500 00	$ 2 643	532,391 20
D	Channeling	Sq. ft	10,000	1.00	10,000 00	1.00	10,000 00	1.35	135,000 00	.58	5,800 00	.95	9,500 00	1 00	10,000 00	85	8,500 00	60	6,000 00	1 75	17,500 00	1 30	130,000 00	1 035	10,480 00
E	Pine and fir timber	1,000 ft. B. M.	15	100.00	1,500 00	100 00	1,500 00	104.00	1,560 00	129.95	1,949 25	100 00	1,500 00	125 00	1,875 00	160 00	2,400 00	150 00	2,250 00	175 00	2,625 00	140 00	2,100 00	128 40	1,925 00
F	Structural steel	Pound	16,000	.10	1,600 00	.10	1,600 00	.12	1,920 00	.152	2,432 00	.10	1,600 00	12	1,920 00	29	3,200 00	10	1,600 00	10	1,600 00	19½	2,360 00	1239	1,983 20
G	Gray iron castings	Pound	20,000	.10	2,000 00	.10	2,000 00	.15	3,000 00	.159	3,180 00	.08	1,600 00	15	3,000 00	17½	3,500 00	08	1,600 00	14	2,800 00	18½	3,750 00	1322	2,643 00
H	Cast iron pipe and specials	Pound	2,060,000	.0476	87,550 00	.08	164,800 00	.06½	133,900 00	.062	127,720 00	.046	92,700 00	12	247,200 00	12½	259,560 00	10	206,000 00	08	164,800 00	06½	133,900 00	0786	161,813 00
I	Concrete	Cu. yds	160,000	6.50	1,040,000 00	6.75	1,080,000 00	6.75	1,080,000 00	7.07	1,131,200 00	9.00	1,440,000 00	9 00	1,440,000 00	11 50	1,840,000 00	11 00	1,760,000 00	9 50	1,520,000 00	11 50	1,840,000 00	8 86	1,417,120 00
J	Metal reinforcement	Pound	11,500	.08	920 00	.10	1,150 00	.07	805,00	.07	805 00	.06	690 00	07	805 00	12	1,380 00	10	1,150 00	08	920 00	07	805 00	082	943 00
K	36" vitrified pipe and specials	Lin. ft	130	15.00	1,950 00	7 00	910 00	11 00	1,430 00	18 29	2,377 70	10 00	1,300 00	7 00	910 00	13 00	1,690 00	6 00	780 00	9 00	1,170 00	10 65	1,384 50	10 69	1,390 18
L	30" vitrified pipe and specials	Lin. ft	700	12 00	8,400 00	6 00	4,200 00	8 00	5,600 00	23 37	9,359 00	7 50	5,250 00	5 00	3,500 00	9 50	6,650 00	5 50	3,850 00	7 00	4,900 00	8 00	5,600 00	8 19	5,730 90
M	24" vitrified pipe and specials	Lin. ft	40	10 00	400 00	5 00	200 00	7 00	280 00	6 33	253 20	4 50	180 00	4 50	180 00	4 50	180 00	3 75	150 00	3 50	140 00	4 40	176 00	5 348	213 92
N	20" vitrified pipe and specials	Lin. ft	180	7 00	1,260 00	4 00	720 00	5 00	900 00	5 07	912 60	3 30	594 00	3 00	540 00	3 80	684 00	3 50	630 00	2 50	450 00	3 35	639 00	4 07	732 96
	18" vitrified pipe and specials	Lin. ft	150	5 00	750 00	3 50	525 00	4 50	675 00	3 94	591 00	3 00	450 00	2 50	375 00	2 80	420 00	3 25	487 50	2 00	300 00	2 95	442 50	3 34	501 60
P	15" vitrified pipe and specials	Lin. ft	80	4 00	320 00	3 00	240 00	4 00	320 00	2 54	203 20	2 10	168 00	1 50	120 00	1 80	144 00	3 00	240 00	1 50	120 00	2 55	168 00	2 55	204 32
Q	12" vitrified pipe and specials	Lin. ft	1,000	3 00	3,000 00	2 50	2,500 00	2 50	2,500 00	1 52	1,520 00	1 50	1,500 00	1 00	1,000 00	1 10	1,100 00	2 75	2,750 00	1 00	1,000 00	1 49	1,400 00	1 827	1,827 00
R	8" vitrified pipe and specials	Lin. ft	100	2 00	200 00	2 00	200 00	2 00	200 00	.941	94 10	.90	90 00	75	75 00	70	70 00	2 50	250 00	80	80 00	90	90 00	1 349	134 92
S	6" vitrified pipe and specials	Lin. ft	2,800	1 00	2,800 00	1 50	4,200 00	1 25	3,500 00	.534	1,775 20	.75	2,100 00	50	1,400 00	50	1,400 00	2 00	5,600 00	60	1,680 00	60	1,680 00	933	2,613 53
T	Pipe railing	Pound	400	.50	200 00	60	240 00	75	300 00	268	107 20	60	240 00	30	120 00	50	200 00	20	80 00	25	100 00	35	140 00	432	172 78
U	Excavation in public utilities tunnel and shaft	Cu. yd	2,250	25 00	56,250 00	25 00	56,250 00	19 00	42,750 00	21 10	47,475 00	34 50	77,625 00	22 00	49,500 00	21 00	47,250 00	35 00	78,750 00	21 00	47,250 00	19 30	43,425 00	24 29	54,652 50
V	Concrete in public utilities tunnel and shaft	Cu. yd	700	25 00	17,500 00	15 00	10,500 00	30 00	21,000 00	9 63	6,741 00	22 30	15,610 00	33 00	23,100 00	14 50	10,150 00	35 00	24,500 00	35 00	24,500 00	26 15	18,305 00	24 558	17,190 60
W	Dry stone packing in public utilities tunnel and shaft	Cu. yd	150	10 00	1,500 00	10 00	1,500 00	8 00	1,200 00	5 62	843 00	3 45	517 50	9 00	1,350 00	4 00	600 00	6 00	900 00	6 00	900 00	7 75	1,162 50	6 982	1,047 30
X	Ventilating blower and motor in public utilities tunnel	Each	1	1,000 00	1,000 00	500 00	500 00	1,100 00	1,100 00	500 00	506 00	415 00	415 00	1,000 00	1,000 00	2,000 00	2,000 00	1,000 00	1,000 00	1,000 00	1,000 00	485 00	485 00	900 60	900 60
Y	Pump motor and extension shaft in public utilities shaft	Each	1	1,500 00	1,500 00	1,000 00	1,000 00	1,900 00	1,900 00	1,935 55	1,935 55	850 00	850 00	1,500 00	1,500 00	2,500 00	2,500 00	1,500 00	1,500 00	1,200 00	1,200 00	1,175 00	1,506 06	1,506 06	1,506 06
Z	14" iron body bronze mounted gate valve in public utilities tunnel	Each	4	150 00	600 00	200 00	800 00	180 00	720 00	281 00	1,124 00	160 00	640 00	550 00	2,200 00	250 00	1,000 00	200 00	800 00	150 00	600 00	175 00	700 00	229 60	918 40
AA	Restoring pavement	Sq. yd	1,000	5 00	5,000 00	5 00	5,000 00	4 00	4,000 00	2 81	2,810 00	6 35	6,350 00	4 00	4,000 00	2 00	2,000 00	4 00	4,000 00	4 00	4,000 00	6 45	6,450 00	4 361	4,361 00
BB	Setting metal work furnished by State	Pound	25,000	05	1,250 00	05	1,250 00	04	1,000 00	04	1,000 00	02	500 00	05	750 00	12	3,000 00	03	750 00	05	1,250 00	11	2,750 00	054	1,350 00
	Total				$1,590,150 00		$1,981,785 00 5,000 00 $1,976,785 00		$2,105,710 00		$2,120,499 20		$2,249,759 50		$2,651,720 00		$2,804,578 00		$2,877,117 50		$2,964,985 00 10,000 00 $2,954,985 00		$3,149,247 50		$2,449,554 57

* See proposal.

ILLINOIS WATERWAY.

CONTRACT NO. 2—CANVASS OF BIDS RECEIVED, JAN. 5, 1926. CONTRACT AWARDED TO WOODS BROS. CONSTRUCTION CO.

Item No.	Item.	Unit.	Quantities.	Wood Bros. Construction Co., Lincoln, Neb.		Spencer, White & Prentis Co. of Illinois, Washington Blvd. Bldg., Detroit, Mich.		Walsh Construction Co., Davenport, Iowa.		Contracting & Material Co., Chicago, Ill.		Greiling Bros. Co., Green Bay, Wis.		Henry W. Horst Co., Rock Island, Ill.		Great Lakes Dredge & Dock Co., 104 S. Michigan Ave., Chicago, Ill.		John Griffith & Sons Co., 112 W. Adams St., Chicago, Ill.		L. E. Myer Co., 53 W. Jackson Blvd., Chicago, Ill.		C. E. Carson Co., Chicago, Ill.		A. Guthrie Co., 608 S. Dearborn St., Chicago, Ill.		Bates & Rogers Construction Co., 715 Old Colony Bldg., Chicago, Ill.		Green & Sons Co., Chicago, Ill.		Average of all bids received.	
				Price.	Amount.	Price.	Amount.	Price.	Amount.	Price.	Amount.	Price.	Amount.	Price.	Amount.	Price.	Amount.	Price.	Amount.	Price.	Amount.	Price.	Amount.	Price.	Amount.	Price.	Amount.	Price.	Amount.	Price.	Amount.
A	Clearing	Lump sum	1		$ 1,000 00		$ 15,000 00		$ 7,000 00		$ 9,700 00		$ 10,000 00		$ 4,000 00		$ 730 00		$ 5,000 00		$ 7,500 00		$ 3,000 00		$ 1,350 00		$ 1,350 00		$ 9,000 00		$ 5,798 00
ffB	Cofferdams, pumping, etc	Lump sum	1		187,000 00		140,000 00		221,706 50		142,600 00		200,000 00		200,000 00		298,219 00		290,000 00		296,500 00		225,000 00		349,040 00		371,000 00		412,020 00		256,391 19
C	Excavating	Cu. ft	409,000	$ 1 40	572,600 00	$ 1 60	654,400 00	$ 1 37	560,330 00	$ 1.80	736,200 00	$ 1 80	736,200 00	$ 1 62	662,500 00	$ 1 36	556,240 00	$ 1 50	613,500 00	$ 1 40	572,600 00	$ 1 85	756,650 00	$ 1 63	666,670 00	$ 1 65	674,850 00	$ 1 80	736,200 00	$ 1 60	653,770 77
D	Channeling	Sq. ft	29,000	1 00	290,000 00	1 00	29,000 00	1 00	29,000 00	1 00	43,500 00	75	21,750 00	1 35	38,570 00	80	23,200 00	1 25	36,250 00	1 00	29,000 00	85	24,650 00	97	28,130 00	1 35	39,150 00	1 20	34,800 00	1 08	31,230 77
E*	Embankment	Cu. yd	1,000	60	600 00	3 00	3,000 00	2 30	2,300 00	2 00	2,000 00	1 00	1,000 00	1 35	1,330 00	2 18	2,180 00	1 50	1,500 00	1 00	1,000 00	1 00	1,000 00	1 40	1,400 00	1 80	1,800 00	1 20	1,200 00	1 56	1,562 31
F*	Stone paving	Sq. yd	1,000	1 70	1,700 00	3 00	3,000 00	3 45	3,450 00	1 50	1,500 00	1 20	1,000 00	3 00	3,000 00	1 46	1,468 00	4 00	4,000 00	2 50	2,500 00	2 00	2,000 00	3 50	3,500 00	2 70	2,700 00	3 60	3,600 00	2 57	2,570 00
G*	Pine and fir timber	1,000 ft. B. M.	50	75 00	3,750 00	100 00	5,000 00	110 00	5,500 00	100 00	5,000 00	125 00	6,250 00	100 00	5,000 00	119 45	5,972 50	150 00	7,500 00	125 00	6,250 00	150 00	7,500 00	125 00	6,250 00	150 00	7,500 00	150 00	7,500 00	121 50	6,074 81
H	White Oak timber	1,000 ft. B. M.	10	175 00	1,750 00	150 00	1,500 00	150 00	1,500 00	200 00	2,000 00	250 00	2,500 00	200 00	200,000 00	182 00	18,200 00	250 00	2,500 00	200 00	2,000 00	250 00	2,500 00	190 00	1,900 00	270 00	2,700 00	240 00	2,400 00	208 25	2,082 31
I	Structural steel	Pound	387,000	09½	36,765 00	10	38,700 00	12	46,440 00	08½	32,895 00	10	38,700 00	11	42,570 00	15½	59,985 00	12	46,490 00	10	38,700 00	10	38,700 00	10	38,700 00	15	58,050 00	12	46,440 00	119	43,314 25
Ja*	Steel Castings	Pound	60,000	16	9,600 00	20	12,000 00	23	13,800 00	15	9,000 00	14	8,400 00	22	13,200 00	227	13,620 00	25	15,000 00	15	90,000 00	18	10,800 00	16	96,000 00	27½	16,500 00	18	10,800 00	194	11,640 00
Jb*	Steel castings	Pound	60,000	14	8,400 00	10		21	12,600 00	14		13	7,800 00	17	10,200 00	20		24	14,400 00	14		16		131	8,280 00	25		17	10,200 00	883	
Kag	Grey iron castings	Pound	36,000	11	3,960 00	15	5,400 00	17	6,120 00	10	3,600 00	11	3,960 00	16	5,700 16		5,832 00	15	5,400 00	12	4,320 00	12	4,320 00	108	3,885 00	21	7,560 00	12	4,320 00	1377	4,956 92
Kb*	Grey iron castings	Pound	36,000	10	3,600 00	08		15	5,400 00	09		10	3,600 00	11	3,960 00	141		13	4,680 00	11		11		087	3,168 00	19		11	3,960 00	1166	
L	Steel forgings	Cu. yd	116,000	20	23,200 00	30	34,800 00	35	40,600 00	25	29,000 00	22	25,520 00	36	37,120 00	36½	42,340 00	30	34,800 00	20	23,300 00	28	32,480 00	25	29,000 00	30	34,800 00	24	27,840 00	275	31,900 00
M	Concrete	Cu. yd	98,200	5 95	584,290 00	6 00	589,200 00	7 76	762,032 00	7 30	716,860 00	7 00	687,400 00	7 75	761,050 00	7 87	772,834 00	7 75	761,050 00	8 40	824,880 00	7 25	711,950 00	7 20	707,040 00	9 65	947,630 00	10 20	1,001,640 00	7 70	755,988 92
N	Metal reinforcement	Pound	164,000	05	8,200 00	06	9,840 00	05	8,200 00	05	8,200 00	06	9,840 00	05	8,200 00	07	11,480 00	06	9,840 00	06	9,840 00	05	8,200 00	06	9,840 00	06½	10,660 00	06	9,840 00	058	9,398 48
O	Vitrified pipe—6" diam	Lin. ft	5,430	40	2,172 00	1 00	5,430 00	58	3,149 40	50	2,715 00	1 00	5,430 00	55	2,926 50	35	1,900 50	60	3,258 00	50	2,715 00	60	3,258 00	75	4,072 50	80	4,344 00	1 20	6,516 00	672	3,688 22
P	Pipe railing and W. S. pipe	Pound	3,000	50	1,500 00	25	750 00	57	1,710 00	50	1,500 00	55	1,650 00	60	1,800 00	28	840 00	50	1,500 00	30	900 00	50	1,500 00	38	1,155 00	36	1,080 00	36	1,080 00	415	1,305 00
Q	Fibre conduit—3" diam	Lin. ft	2,750	H 30	825 00	50	1,375 00	70	1,925 00	40	1,100 00	50	1,375 00	33	907 50	52½	1,443 75	50	1,375 00	40	1,100 00	30	825 00	45	1,237 50	27	742 50	60	1,650 00	148	1,221 63
R	Gravel road	Lin ft	3,700	2 00	7,400 00	2 00	7,400 00	2 60	9,620 00	2 00	7,400 00	2 00	7,400 00	2 65	9,805 00	4 55	16,835 00	2 50	9,250 00	2 25	8,325 00	2 00	7,400 00	3 00	11,110 00	3 75	13,875 00	2 40	8,880 00	2 59	9,591 59
S	30" sluice gate	Each	1	350 00	350 00	500 00	500 00	670 00	670 00	500 00	500 00	500 00	500 00	680 00	680 00	451 00	451 00	600 00	600 00	550 00	550 00	500 00	500 00	506 00	500 00	500 00	500 00	420 00	420 00	517 46	517 46
T	6" gate valve	Each	1	30 00	30 00	100 00	100 00	45 00	45 00	50 00	50 00	48 00	48 00	60 00	60 00	20 00	20 00	125 00	125 00	50 00	50 00	50 00	50 00	38 50	38 50	35 00	35 00	60 00	60 00	54 75	54 75
U	6" flap valve	Each	1	15 00	15 00	100 00	100 00	16 00	16 00	25 00	25 00	28 00	28 00	21 00	21 00	55 00	55 00	75 00	75 00	40 00	40 00	25 00	25 00	12 10	12 10	65 00	65 00	24 00	24 00	38 55	38 55
V	Bronze nute, etc	Pound	250	50	125 00	1 00	250 00	1 00	250 00	1 00	250 00	1 00	250 00	1 00	400 00	85	212 50	2 00	500 00	60	150 00	1 00	250 00	82½	206 25	1 35	337 50	60	150 00	1 03	256 25
	Total				$1,475,832 00		$1,556,745 00 5,000 00 $1,551,745 00		$1,725,365 90		$1,755,595 00		$1,769,201 00		$1,801,040 00		$1,817,670 25		$1,849,463 00 25,000 00 $21,824,463 00		$1,841,120 00		$1,842,558 00		$1,875,385 85		$2,197,229 00		$2,326,380 00 10,000 00 $2,316,380 00		$1,833,552 53

* See proposal.

tion of the lock walls, valves and upper gates. The lock is located at the upper terminal of the Illinois Waterway and adjacent to the Chicago Sanitary Canal lock. This lock will connect the Sanitary Canal and Lake Michigan with the DesPlaines River at Lockport, Illinois, and has a lift of thirty-five to forty-one feet, depending upon the quantity of water being used by the Sanitary district power plant, and the stage of water in Lake Michigan.

The site of the Lockport lock was not explored by core drilling in 1920, as were the sites of all other locks and dams. The cost of core drilling this site would have been about $10,000.00, and in view of what was known as the character of the foundation material in the immediate vicinity, as shown by the excavation for adjoining Illinois and Michigan Canal lock and the Sanitary District power house, it was decided that the State would assume the risk of possible poor foundation material and pay the contractor for extra work necessitated by poor foundation, if such were encountered. The foundation material proved to be good except for a few clay pockets. These pockets were excavated and either filled with concrete, or covered with reinforced concrete plugs. The total cost of this extra work amounted to $1,443.39, or about 14 per cent of what the drilling would have cost.

On January 5, 1926, proposals were opened at Springfield, Illinois, for Contract 2, constructing of Starved Rock lock and dam, and for Contract 6, for retaining walls through the city of Joliet. The abstract of bids received for these contracts is appended hereto, as well as the abstract of bids received on June 8, 1926, for Contract 4d, which covered the fabrication and erection of the miter gates for the Lockport and Marseilles locks. Bids of Contract No. 6 were rejected.

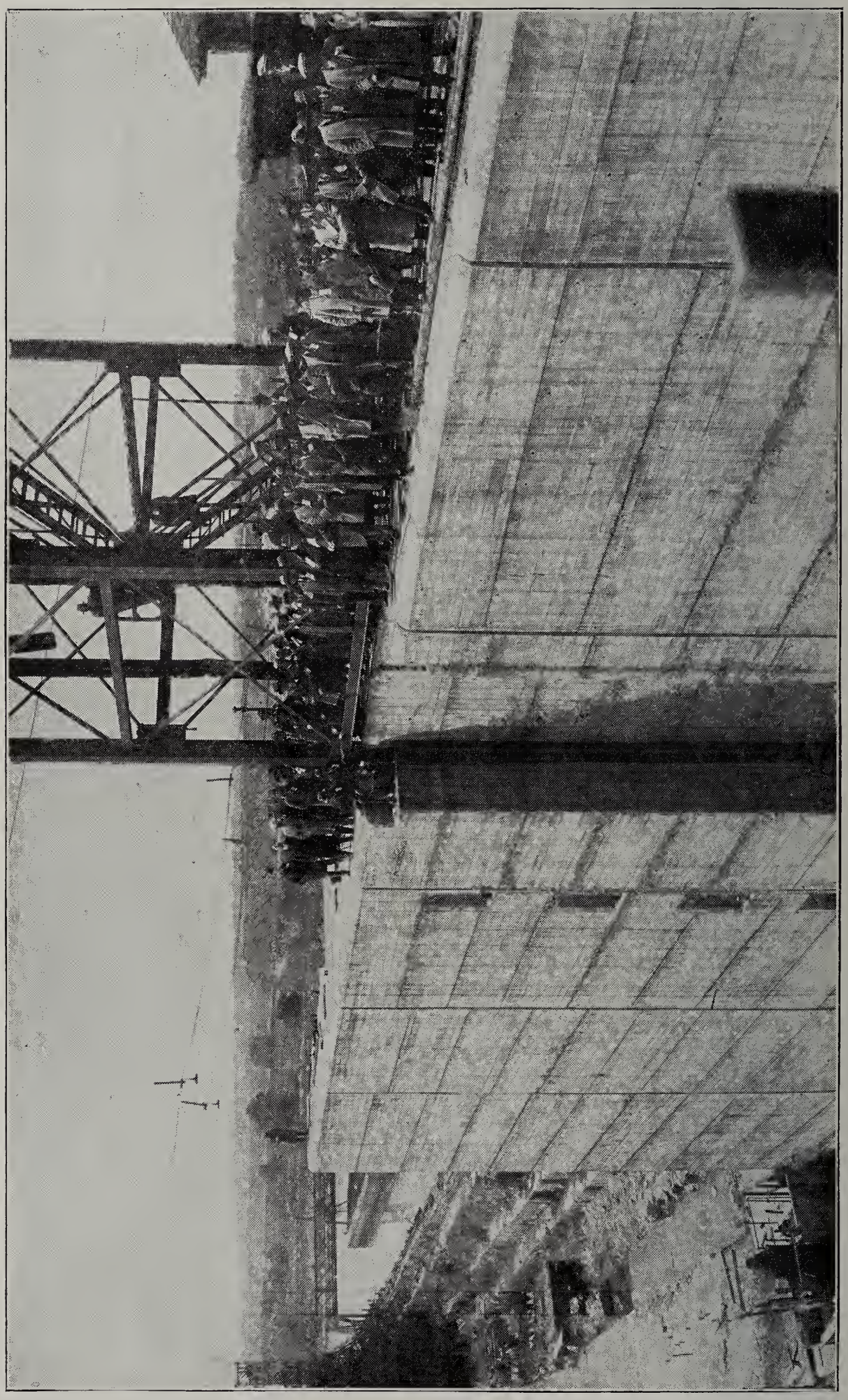
Contract No. 2 was awarded on February 5, 1926, to the Woods Bros. Contsruction Company, of Lincoln, Nebraska. Contract 4d had not been awarded at the end of the fiscal year.

The work performed by contractors and by our field engineering force is set forth in detail in the report of the Division Engineer, J. B. Bassett, appended hereto.

At the Chicago office satisfactory progress has been made on the completion of plans and specifications for new work, work of routine nature and the preparation of detailed plans of work under construction.

At the beginning of the fiscal year the engineering force occupied on "Illinois Waterway" work consisted of the Assistant Chief Engineer, engaged chiefly in executive duties, one Chief Designing Engineer, one Assistant Engineer and one Draftsman. During the year the engineering force was augmented by the addition of four assistant engineers and one draftsman. This force was called upon much of the time for detail on work not connected with the Illinois Waterway. Approximately 25 per cent of the time of the force was thus occupied.

A detailed report of the engineering activities of the designing force has been submitted by Walter M. Smith, Chief Designing Engineer, which report, among other things, contains the following information of general interest.



Group of business men representing the Illinois Chamber of Commerce inspecting progress of work in construction of the "Illinois Waterway," the connecting link in navigation from Lake Michigan to the Gulf of Mexico.

LOCKPORT LOCK.

Several clay pockets were encountered in excavating for the Lockport Lock. These were cleaned out and filled with concrete. One large pocket was cone shaped and very deep and the clay was excavated for a depth of about 5 feet and then covered with a reinforced concrete slab which plugged the hole.

* * * * * *

Flat plates supported by intercostal stiffener were substituted for the buckle plate skin of culver valves.

* * * * * *

Paint tests conducted during the last year developed that red lead and boiled linseed oil was superior to any of the special trade marked protective coating tested in resisting the attack of sewage laden water, and, therefore, red lead and boiled linseed oil has been adopted to protect the submerged metal work at this and other lock and dams of the Illinois Waterway.

* * * * * *

Work was continued on contract drawings and specifications for work not yet placed under contract.

* * * * * *

An examination was made of the sample metal work, consisting of a plate of Monel metal riveted between two steel plates, one of structural and one high carbon grade, and which had been submerged for two years in the sewage laden water of the Illinois and Michigan Canal at Joliet. The Monel metal was bright and showed no evidence of corrosion or electrolytic action between it and the steel. On account of this showing Monel metal has been specified for the pintles and pintle bushings of all miter gates

Annual reports of engineers assigned to special duties were made by the following and appended hereto in the order listed.

J. B. Bassett, Division Engineer.
Murray Blanchard, Hydraulic Engineer.
M. C. Sjoblom, Sanitary Engineer.
W. G. Potter, Drainage Engineer.
H. C. Alexander, Office Engineer.

ANNUAL REPORT OF J. B. BASSETT, DIVISION ENGINEER.

A report of operations in the Ottawa Division of the Illinois Waterway for the year ending June 30, 1926 is presented below:

ENGINEERING.

The engineering work carried on from the Ottawa Division Office during the year consisted of incidental surveys and investigations only, which were needed from time to time, the force consisting of the Division Engineer and two assistants for a portion of the time.

The preparations of a topographic map of the Illinois River by means of tracings from the appropriation survey maps, which was under way at the beginning of the year was continued covering the territory along the river from Grist Island to Marseilles, a distance of about ten miles.

Core borings under contract at the site of the Starved Rock lock and under the DesPlaines River, at Joliet, were supervised. An inspector was provided for full time at the former location and for part time at the latter location.

Water profiles in the head-race of the Marseilles Land & Water Power Company, at Marseilles, Illinois, were determined and tracings thereof were forwarded to the Chief Engineer.

Cross sections of the so-called "River Road," west of Ottawa, at a point where the road will be subject to overflow by reason of the construction of the Starved Rock dam, were platted and the quantities of fill necessary to raise the road above water line were computed.

A site map of the Starved Rock lock and dam was platted for use in locating the lock and dam and for use during construction.

Numerous surveys pertaining to the Illinois & Michigan Canal were made as follows:

Profiles of the canal bank and bottom were extended from the Little Vermillion aqueduct, at LaSalle, to Lock No. 15, at the entrance to the LaSalle Basin, and a mud bar at the junction of the basin with the Illinois River was surveyed and platted.

A profile was run on the canal bank between Locks No. 11 and No. 12 and grades stakes were set for bank raising. A short profile was also run on the canal bank in the vicinity of Carson Creek where the bank was reported to be low.

A portion of the canal bank between Split Rock and Rockwell, near LaSalle was cross-sectioned the sections were platted, and quantities were computed for the filling necessary to strengthen the bank. A report was made and forwared to the Canal authorities.

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Surveys of the sites of the Columbus Street Bridge, at Ottawa, of the Matchtown and Gum Creek culverts, at Marseilles, and of a culvert east of Utica were made and platted. A preliminary design for estimating purposes was under way for the Utica culvert.

Surveys were made to determine miter sill and breast-wall elevations on the Canal locks at Channahon and Joliet and a skeleton profile of the entire canal was platted.

Sketches were made from measurements of the various lock-gates on the Canal for an office record.

Water gauges were set at the various locks on the Canal.

Supervision was given to the clearing of a culvert under the canal west of Utica.

During July, August and September, 1925, almost continuous attention was given by the Division Engineer to the operations of the derrick-boat on the canal which was working to remove bars in the canal which prevented navigation.

CONTRACT NO. 4.

Contract No. 4, which is the construction of a lock at the lower end of the Sanitary District Canal, near Lockport, Ill., by Green & Sons Co., under contract dated October 8, 1923, was carried on at a fair rate of speed during the year. Weather conditions were fair except during the winter months when some time was lost. This work is being carried on under the personal supervision of R. S. Heath, Resident Engineer.

PLANT:

The plant receipt and erection was practically completed at the beginning of the year, there being added only some concrete buckets and chutes and a derrick for handling concrete and steel to points inaccessible to the cableway.

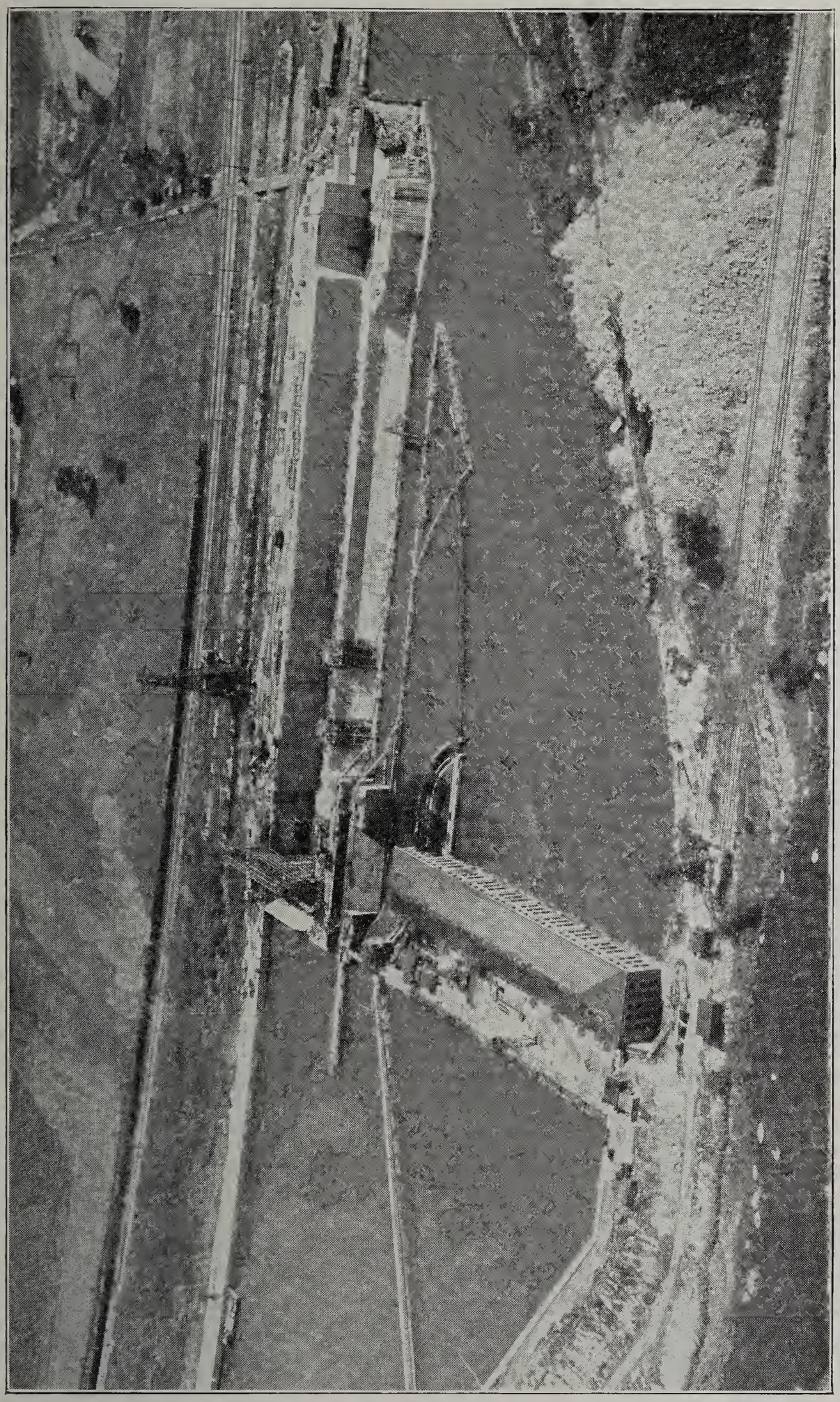
EXCAVATION:

The excavation of lock was continued by use of shovel No. 70 during the entire year, by shovel No. 18 during the first three months and by occasional hand work during the entire year. The work for the shovel was completed at the end of the year, leaving some trimming in the lock floor to be done by hand.

COFFERDAMS:

Coffefferdam construction at the southwest corner of the lock, under way at the beginning of the year, was carried to completion. The cofferdam was built in four sections. The first three were removed after the enclosed concrete retaining walls were constructed. The fourth section encloses the lower end of the lock and is still in place.

Lockport Lock as of June 30, 1926, showing construction work. The walls of this lock are 65 feet high, and over 600 feet long. It provides for 14 feet of water over the miter sills, with a lift of 41 feet, being the highest of its type in the world.



Birdseye view of Lockport lock of the Illinois Waterway. This lock has a lift of 41 feet, is 110 feet wide and 600 feet usable length. It connects the Chicago Sanitary Canal, at left, which is the same level as Lake Michigan, with the DesPlaines River. Sanitary District power plant in foreground. Copyright, Chicago Aerial Survey Co.

CHANNELING:

Channeling was continued during the year as the work progressed, principally along the west face of the excavation and along the breast and gate walls.

STRUCTURAL STEEL:

The erection of structural steel, other than the occasional pieces which were incorported in the concrete as the work progressed, was begun in December, 1925 by way of the erection of the west lift tower for the upper service gate. This work was continued by the erection of the west guard gate tower, the guard gate itself, and the partial erection of the overhead foot bridge. Work was begun on the east guard gate tower.

CONCRETE:

The placing of concrete was carried on during the entire year except during the winter when conditions were unfavorable. By November, 1925 the entire east wall, except the stairway sections at the lower end, and the difficult work on the west wall alongside of and under the Sanitary Canal lock, had been placed. During the spring the upper end of the west wall was completed, except section No. 1 at the Sanitary Canal junction and several main chamber sections were completed along the lower west wall.

Various items of forgings, castings, timber, etc. were incorporated in the concrete as the work progressed.

The progress to date is shown as follows:

Character of Work	Completed to date	Amount Earned
Clearing	100%	$ 8,750.00
Cofferdam	93%	176,700.00
Excavation	142,982	285,964.00
Channeling	41,925	20,962.50
Pine & Fir Timber	6,364	636.40
White Oak Timber	1,080	216.00
Structural Steel	1,137.548	113,754.80
Steel Castings	47,914	8,145.38
Gray Iron Castings	17,836	2,140.32
Steel Forgings	26,750	6,420.00
Concrete	64,946	428,643.60
Metal Reinforcement	30,569	1,528.45
30-inch Vitrified Pipe	15	75.00
30-inch Vitrified Pipe Specials	4	64.00
24-inch Vitrified Pipe	73	219.00
24-inch Vitrified Pipe Specials	11	132.00
18-inch Vitrified Pipe	441	1,190.70
18-inch Vitrified Pipe Specials	37	296.00
8-inch Vitrified Pipe	151	151.00
6-inch Vitrified Pipe	844	126.60
4-inch Vitrified Pipe	8	3.20
1, 2, 4½ & 6-inch Wrot Steel Pipe & Railings	6443	966.45
6-inch & 8-inch Cast Iron Pipe & Specials	8919	624.33
Valve Sets for Shutter Gates	5	1,950.00
3-inch Fiber Conduit	2275	910.00
Lift Gate Machinery	40.9%	16,360.00
Gates for Culvert Valves	22.8%	1,824.00
Extra No. 1 complete		60.00
Extra No. 2 complete		28.00
Extra No. 3 complete		1,443.39
Total		$1,080,285.12

From a financial standpoint the contract is about 78 per cent completed.

CONTRACT NO. 2.

IN GENERAL:

On January 5th, 1926 proposals were opened at Springfield, Illinois for the construction of the Starved Rock lock and dam, the work being designated as Contract No. 2.

The contract for the construction was let to the lowest bidders, the Woods Bros. Construction Company of Lincoln, Nebraska, about February 5th.

On February 23rd, Mr. C. R. Andrew reported for duty as Resident Engineer and Mr. A. N. Dunaway was detailed from the Division Office as instrumentman. Preliminary work was then commenced.

Mr. Geo. K. Leonard, General Superintendent for the Contractor, visited Ottawa on the 24th to make preliminary arrangements for the construction.

On March 10th, Woods Brothers and the Wilson Engineering Company, sub-contractors for the excavation, opened offices in Ottawa.

Actual work was started by way of excavation of a diversion ditch, on March 18th, 1926, at 2:30 P. M.

PLANT:

The plant received to the end of the year consisted of three 45-foot boom caterpillar dragline excavators with boom and dippers for conversion into gasoline shovels, 40 five-yard dump cars, track material, four gasoline locomotives, one tractor, two pumps, one saw, one light plant and one spreader car; one office, one mess hall, and five bunk houses were constructed.

EXCAVATION:

The work of earth excavation, started on March 18th, has been carried on continuously except from April 3rd to April 25th, inclusive, when the site was flooded by high water in the Illinois River.

A diversion ditch has been constructed and the old ditch cleaned out to the north limits of State property. An empounding dam was constructed around the lock area and a portion of the headgate structure, and earth excavation has been carried on along the headgate site and in the lock area. Except for the portion of the excavated material used for compounding dam, the waste material has been dumped from trestle on the waste area.

No rock excavation has been under way except for a sump and some ditching.

No work other than excavation and clearing has been started.

The progress to date is shown as follows:

Character of work	Completed to date	Amount Earned
Clearing	80%	$ 800.00
Cofferdam	33.8%	63,206.00
Excavation	81,400 yds.	113,960.00
Total		$177,966.00

The contract is about 12 per cent complete from a payment standpoint.

CORE BORINGS AT STARVED ROCK AND JOLIET.

The Longyear Exploration Company, of Minneapolis, Minnesota, under contract for core borings at Starved Rock and Joliet, were operating at the beginning of the year at the Starved Rock site. This work was continued to completion on July 14, 1925, a total of 462.5 feet of holes having been bored.

The outfit was then moved to Joliet where holes were bored on each side of the DesPlaines River and across its bed. The work was completed on August 28th, a total of 424.4 feet of holes being bored at this point. A good percentage of core was recovered with no indications of clay pockets

One hole was redrilled on the west bank of the river on account of soft rock in the original hole at that point.

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ANNUAL REPORT OF MURRAY BLANCHARD, HYDRAULIC ENGINEER.

Maps, profiles and hydrographs were prepared for use in congressional hearings. Preliminary designs of regulating works for the Niagara and St. Clair Rivers were made, the effect of such works on the levels of Lakes Erie and Michigan-Huron were computed, and their cost was estimated. Studies were also made of the St. Marys and Detroit River hydraulics.

ILLINOIS AND DESPLAINES RIVERS.

Hydraulic studies were made in connection with problems of navigation, design and water power on these streams.

Data were compiled relating to water power rights at Marseilles and along the DesPlaines River.

DAMS.

At Anna the dam at the outlet of the State Hospital reservoir was repaired. Specifications were written, contract let and the work supervised at the request of the Department of Welfare. Leakage at numerous places was stopped by application of waterproofing cement on the face and back of the dam.

At McHenry the lock and dam, recently acquired by the State, have required considerable attention for maintenance. A study of the backwater and wind effects on the levels of Fox Lake was made to determine the regulation requirements for holding the chain of Fox River Lakes at uniform and satisfactory stages.

MISSISSIPPI RIVER.

Investigation and report was made for the Department of Welfare of the bank erosion along the Mississippi River on the State property at Menard. It was found that the U. S. Engineer Department were preparing plans for proposed works to control the channel flow so as to protect the banks and prevent further erosion.

INVESTIGATIONS.

Miscellaneous investigations and reports were made on the hydraulic aspects concerning permits for the construction of bridges, dams, reservoirs, culverts, etc.

Reports were made on numerous hydraulic problems relating to the Illinois Waterway and streams throughout the State.

ANNUAL REPORT OF M. C. SJOBLOM, SANITARY ENGINEER.

With the increasing demand for modern water and sewerage facilities, especially in the smaller communities throughout the State, the problem of maintaining our streams sufficiently pure to support fish life is becoming daily a more urgent problem. These modern conveniences are being demanded but the public is at the same time gradually coming to realize that our streams, if preserved in reasonably pure condition are a great asset. As a result there is a growing tendency toward planning more adequate sewage treatment works for the various communities.

One of the more important agencies helping to mould public opinion in favor of cleaner streams is the Izaak Walton League with its chapters throughout the State. The League is decidedly active in bringing to the attention of the proper authorities as well as the public the places where fish and other life are being destroyed or threatened with destruction from the pollution of public waters.

Among other accomplishments this Division has, through its influence secured treatment of wastes at several of the larger canning factories in the State. These wastes are very putrescible and by their great avidity for oxygen have taken from the water this life sustaining element in its

free state and vast numbers of fish have died in the streams receiving such wastes. There still remains considerable work in order to induce all the canning factories to treat adequately their trade wastes.

Milk wastes like cannery wastes are highly putrescible and require treatment unless discharged into streams having considerable flow. The quantities of milk wastes are relatively small but the wastes are so strong, and the streams into which the majority of the factories discharge so limited in flow that numerous complaints of nuisances as well as of the killing of fish are received. At present several milk plants, at our request, are planning to treat their wastes.

During the past year the writer has passed upon some forty-five sewerage systems or sewage treatment plants, and has recommended thirty-seven permits for improvements of this nature. In all some 105 visits to different parts of the State were made for various purposes, the majority, being in connection with alleged pollution of streams or with proposed sewerage improvements.

THE FEDERAL GOVERNMENT AND STREAM POLLUTION.

The interest of the Federal government in the subject of stream pollution in Illinois is indicated by the following report of recent investigation of the Rock River and its tributaries:

WAR DEPARTMENT.

UNITED STATES ENGINEER SUB-OFFICE.

Sterling, Ill., April 20, 1925.

From: Assistant Engineer C. M. Waters.
To: The District Engineer, Rock Island, Ill.
Subject: Investigations of Pollution of Rock River and its Tributaries.

1. The survey of 1912-13, and its report on the proposed improvement of Rock River, extended from Sterling, Ill., to Janesville, Wis., a distance of 110 miles. That part of the river down stream to the mouth of the Illinois and Mississippi Canal at Lock 29, is used slightly by launches. From Lock 29 to Lock 30, a distance of ten miles, the river has been improved for navigation purposes, from which point the canal follows one bank of the river, or nearby, to the Mississippi River just below Rock Island, Ill.

2. This report will deal with the Rock River from Janesville, Wis., to the Mississippi River below Rock Island and will touch only slightly on two of its tributaries, Pecatonia River, entering the Rock River near Rockton, Ill., and Green River, entering the Rock River near Geneseo, Ill.

3. There are few towns of any size on the river above Janesville, Wis., and the sewage from them is unimportant.

JANESVILLE, WISCONSIN.

4. Janesville, Wis., is a thriving manufacturing city of about 20,000. All of its sewage, sanitary, industrial and storm, is emptied into Rock River, untreated. In anticipation of the time when they may be required to treat it, the city has collected most of it in two interceping sewers and led them to the lower end of the city, where a disposal plant will eventually be built to care for both lines of sewer. The industrial plants there that discharge sewage into the river include a gas tank, a sugar beet factory, which uses large quantities of sulphuric acid, a wire and nail mill which uses some acid in the galvanizing process, an automobile assembling plant and an auto body plant, both of which use acid in cleaning their raw products, and dump the used acid into the sewer. There is a canning factory that puts up peas, cabbage, corn and sauerkraut, a factory for making coloring dyes and a woolen mill.

5. The sanitary inspector some time ago required the beet sugar factory to discharge their sewage into a settling basin before reaching the river.

6. An analysis of the river water above and below the city in August, 1922, showed 1120 colon baceria per c.c. above and 1650 per c.c. below the city.

7. The Health Officer is Dr. T. B. Welch and the Sanitary Inspector Dr. L. J. Woodworth, both of whom seem anxious to cooperate in ridding the river of pollution.

8. Dr. Woodworth reports that the records of the water company show the pumpage for 1924 for the city was 608,274,628 gallons, of which 372,-650,168 gallons were metered, the difference being due to flat rates on hydrants, drinking fountains, sprinkler systems, etc.

BELOIT, WISCONSIN.

9. Beloit, Wisconsin, is about fifteen miles below Janesville. It is a town of about 18,000 and has a considerable amount of manufacturing. All the sewage is taken to the river untreated, except that from a small sewer that discharges through a septic tank into Tuttle Creek, which empties into Rock River through the town of South Beloit, Ill. The two towns are separated only by the state line. The Health Department and City Engineer of Beloit are working on plans to eventually build a disposal plant in South Beloit for the use of the two cities. Beloit is now laying a system of large storm and sanitary sewage.

10. The industrial plants of Beloit discharging sewage into the river include Beloit Iron Works, whose entire product is paper mill machinery, Yates Machine Co., Fairbanks-Morse Co., with a large foundry and machine plant, the gas plant owned by Beloit Water, Gas and Electric Co., and a paper mill. Beloit Iron Works and the paper mill are located with many small factories on an island in Rock River. Whatever sewage they have must go directly into the river, and untreated. Nothing was found to indicate how serious or offensive this may be. This plant has recently acquired a new site in South Beloit and will probably be moved. If they have any objectionable sewage other than domestic, it is probably acids.

11. The sewage from the paper mill may be objectionable but as the plant is built out over the river it is impossible to see what they are discharging.

12. It is popularly believed that the sewage from the large plant of Fairbanks-Morse Co. contains a large amount of acid.

13. The gas plant is located in the extreme lower end of the city, on the river bank. It is a water gas plant and discharges its sewage, untreated, into the river. The amount is small and seems to be harmless. No tar was seen in it and, being a water gas plant, it contains no ammonia.

14. The water pumpage as shown by the records of the water company averages 350,000 to 400,000 gallons per day, of which, their superintendent estimates, 85 per cent reaches the sanitary sewers.

15. The Health Officer of Beloit is Dr. L. M. Field and the City Engineer is G. E. Heebink.

SOUTH BELOIT.

16. South Beloit, joining Beloit, Wis., on the south, is a residential and manufacturing community with no mercantile section. Its population is probably not over 3000. It has no sanitary sewers. There are a few factories located there, with propects of a large increase in their number. The plants now located there include a refrigerator plant, knitting mill, dye plant, and some founlries and small shops in the metal trades.

17. It is reported that the knitting mill discharges at times quite large quantities of dye into its sewer, with outlet in Tuttle Creek, not far from its mouth. It is reported that dead fish are frequently found there. However at the time of inspection there was nothing on the creek bank to indicate the large discharge of dye.

18. The creek itself is a menace because in dry seasons its discharge is almost zero and in flood it spreads over a wide area, including streets and yards. Any sewage reaching it is then a danger in either high or low water.

PECATONICA RIVER.

19. The Pecatonica River, with a drainage area of about 2,600 square miles, discharges into Rock River about three miles below South Beloit, near Rockton. It has little sewage with the exception of that from the city of Freeport, Illinois.

FREEPORT, ILLINOIS.

20. The city of Freeport, located on Pecatonica River some 40 miles above its confluence with the Rock, has a population of about 20,000. The water company shows a pumpage record of 571,343,554 gallons for 1924. About 85 per cent of the city is covered by the sewer system, which has six outlets into the river, in addition to some private outlets from factories and railroad shops. There are no plants for treating the sewage. An analysis of the river water at Freeport, March 16, 1925, showed the following: Turbidity-150; Colon-80; total bacteria per c.c., 560; residue-366.

21. The industrial plants include the Stover Mfg. Co., Woodmansee Mfg. Co., a water gas plant and several other factories whose sewage is probably not very dangerous. The Stover and Woodmansee plants have as a part of their product windmills and pumps. A large amount of galvanizing is done in this work, using large quantities of sulphuric acid. The Rawleigh Co. manufacture a large line of toilet preparations, medicines, etc., but there is nothing in sight to indicate any dangerous pollution from the plant.

22. The gas company has a water gas plant, making an average of 13,000,000 c.f. per month. The sewer from their plant was about 6-inch and was running half full. The discharge appeared to contain some tar but no ammonia.

23. The City Engineer of Freeport is A. F. Stanley.

ROCKTON, ILLINOIS.

24. Rockton, just below the mouth of the Pecatonica, is a town of less than 1000 population, with no sanitary sewers. The American Tar Products Co. has a roofing paper plant on the river bank but do not use any tar and apparently has no offensive sewage.

ROCKFORD, ILLINOIS.

25. Rockford occupies both banks of Rock River at a point 45 miles below Janesville, by river. It has a population of about 75,000. The Health Commissioner, Dr. N. O. Gunderson, is very active in his department, and surveys and plans are now being made for the organization of a sanitary district. The entire city and the adjacent territory out for about three miles, is being mapped with a two-foot interval contour map. It is planned to lay intercepting sewers and two disposal plants to care for all sanitary sewage. At present there are approximately 91 sewer outlets, public and private, discharging into Rock River and Kent Creek. There are no treating plants for sewage. It is estimated by the Health Commissioner that the average sewage discharge is 9000 gallons per second, or about one-third of 1 per cent of the average discharge of the river. It is reported that Rockford has about 350 factories, all discharging any sewage they may have either into Rock River or Kent Creek, which empties into the river within the city limits. This number, of course, includes many plants whose sewage is not objectionable, for instance the many furniture plants within the city. There are seven or eight large knitting mills in the city using quantities of black and sulphur dye, much of which finds its way to the river. Two or three wire mills use in their process sodium cyanide and muriatic acid. The vats are usually cleaned daily, so much of this acid reaches the river. One tannery is located on Kent Creek and discharges its sewage into the creek. The discharge contains tannic acid and lime. The tannic acid is objectionable from the viewpoint of fish life conservation. The gas company, through its sewers, discharges into Kent Creek sulphur compounds and coal tar.

26. The amount of industrial waste reaching Rock River from Rockford factories is covered in more detail in the report of Dr. N. O. Gunderson, Commissioner of Health, which is herewith.

KISHWAUKEE RIVER.

27. About five miles below Rockford, the Kishwaukee River, with a drainage area of about 1200 square miles, discharges into Rock River. This river, through its tributaries, receives the sewage from the towns of Belvidere and DeKalb. The former has a population of about 7,500 and not very much manufacturing. It is about eighteen miles from Rock River. DeKalb has a population of perhaps 9000 and has some large wire and steel mills, using large quantities of sulphuric acid. As it is about forty miles from Rock River, however, the effect of its sewage is probably not seriously felt there.

OREGON, ILLINOIS.

28. Oregon, located about twenty-five miles below Rockford, has a population of about 2300. About two-thirds of the area of the town has sewers leading to Rock River through five outlets. They hope at some future date to lay an intercepting sewer along the river front to collect all the sanitary sewage. The water department records show a total pumpage of 106,000,000 gallons for 1924. This amount seems unreasonable for a town of its size and an estimate of sewage based on pumpage records would not be reliable. The manufacturing consists of a piano plant, foundry, oil sprinkler plant and milk condensery, none of which have sewage that is very objectionable. The acid used in testing milk is not discharged into the river. The bulk of their sewage is washings from milk containers.

DIXON, ILLINOIS.

29. Dixon, a city of about 9000, is about 95 miles below Janesville on Rock River. It has twelve sewer outlets into Rock River. The Dixon Water Co. in 1924 pumped about 226,000,000 gallons, of which about 110,000-000 gallons was metered.The only manufacturing plant in the city, of interest in this report, is the Reynolds Wire Co. plant the output of which is wire screen. They use daily about a ton of sulphuric acid, one-quarter ton of muriatic acid and smaller quantities of blue vitrol and soap flakes. No lime is used to neutralize the acid dumped into the sewer.

30. On the east bank of the river, north of the city limits, is located the Sandusky Cement plant. There is apparently no offensive sewage there. Immediately west of the city, near the north bank of the river, is the Borden milk plant. They have their own pumping plant and sewer system. The acid used in testing is not thrown into the river. The sewage is washings from milk containers.

31. On the west bank of the river, north of the city limits, is located the State Epileptic Colony, having its own water supply and sewer system. They have filter beds for their sewage but on the day of inspection the plant was not working and raw sewage was passing on to the river. The colony houses about 1900 patients and employees.

32. The Illinois Northern Utilities Co. has a coal gas plant on the river bank. The sewage from this plant is carried by a 6-inch sewer to a level area back of the river bank and there allowed to settle. They apparently depend on evaporation and seepage to take up the liquid matter. In flood seasons this area is covered by back water from Rock River. The sewage from the plant contains ammonia, carbon dioxide, and hydrogen disulphide. There is not much evidence of tar in the sewage.

STERLING AND ROCK FALLS.

33. Sterling, a town of 9000, and Rock Falls, having a population of about 3000, are manufacturing towns on the north and south banks of Rock River, 110 miles below Janesville. The sewage of both towns is taken into the river untreated. One sewer from Sterling reaches Elkhorn Creek, which discharges into the river below the city. The Sterling Water Co.,

serving both towns, pumped 371,020,700 gallons in 1924, of which 98,603,000 gallons was metered. The manufacturing plants in Sterling of interest in this study are National Mfg. Co., Lawrence Bros. and Frantz Manufacturing Co., whose product is building hardware, Northwestern Barbwire Co. and Illinois Northern Utilities Co. gas plant.

34. The gas works is a coal gas plant. They have an 8-inch sewer into the river as an overflow from their tar well. There is indication that some tar, probably a small amount, gets into the river. The sewage, however, is strongly saturated with ammonia. It is reported that when the discharge from the acid cleaning tanks of the wire mill just upstream from the gas plant and the sewage from the gas plant come in contact the combined sewage immediately turns black and is seen for some distance down the river. There is no indication, however, of a large amount of tar reaching the river. The superintendent of the gas plant tested the discharge from the sewer and said it was strong of ammonia.

35. Mr. L. G. Adams, Chemical Engineer for the Utilities Co., stated that the waste from both the Sterling and Dixon plants was a solution containing ammonia, carbon dioxide and hydrogen disulphide. In the laboratory he performed experiments tending to show that the dark color of the sewage at times below their outlet was not caused by tar but rather by a chemical combination of the iron and sulphuric acid from the wire mill with the ammonia from the gas plant.

36. It is difficult to obtain reliable information from the Northwestern Barb Wire Co. relative to pollution. However they manufacture a large amount of barb wire and woven wire fencing. Before drawing the wire, all the rods are cleaned in a solution of sulphuric acid. The vats are dumped daily when the plant is running one shift only. It is reported that they use from eight to ten tons of sulphuric acid per day, on an average, and about 150 pounds of muriatic acid per day.

37. The National Manufacturing Co. buy cold drawn rods for their raw product and do not do cleaning or "pickling" with sulphuric acid. They use some muriatic acid in their plating room but the quantity is not large. The same is true of the Lawrence Bros. plant. The Frantz Mfg. Co. do no pickling or plating.

38. In Rock Falls are several large manufacturing plants, among which are Russell, Burdsall & Ward Nut and Bolt Co., International Harvester Co., Sterling Mfg. Co., and a paper mill. The last two mentioned have been closed several years. It is not believed that the International Harvester Co. discharge harmful sewage.

39. Russell, Burdsall & Ward use annually about 450 tons of sulphuric acid in cleaning and pickling steel rods. The solution, as mixed up, is 4 per cent to 5 per cent acid. About twice a week the vats are cleaned and emptied into the river. The acid solution is then about 1 per cent and the color of iron rust. This solution is passed through lime vats containing four or five barrels of lime to neutralize the acid. This office does not know to what extent the acid is neutralized in the process. This firm uses some muriatic acid in galvanizing but the quantity is not large.

40. A mile below Sterling, near the river, is located a plant of the Borden Co., whose product is condensed milk. They have an 8-inch sewer into the river. The greater part of its discharge is washings from milk containers. They use about 60 pounds of sulphuric acid per month in testing milk. It is thrown into the sewer.

STERLING TO ROCK ISLAND.

41. Between Rock Island and Sterling there is little chance for the river to become polluted with sewage. Lyndon and Prophetstown small country towns are on its banks but have practically no sanitary sewage reaching the river and no industrial sewage. Green River entering Rock River 13 miles above the mouth of the Rock, receives the sewage from Geneseo a town of 4500 about 12 miles above its entrance into Rock River. Geneseo's sewage is run thru a settling tank but is often very offensive

when it reaches Geneseo Creek about 1000 feet from its entrance into Green River.

42. A small section of the residence section in the south end of the city of Rock Island has its sewer outlet into Rock River near its junction with the Mississippi River.

ROAD OIL AND OILS FROM AUTOMOBILES.

43. It has been noticed that many of the cities are now using large quantities of heavy road oil on the streets. It is sometimes laid very thick and a rain following soon after the oiling carries quantities of it to the sewers. The automobile has also contributed a source of oil for the sewers. The many oiling stations and garages send quite a large amount of worn out crank case oil to the sewers. In Rockford alone it is estimated that there are 13,000 automobiles and the Health Commissioner estimated that 1 per cent of their oil and grease finally reaches the sewer.

CONCLUSION.

44. The study of Rock River brings to light that there is a feeling that eventually all cities on the banks of the river will be compelled to render their sewage harmless before discharging it into the river. In some of the cities their sewage system is being planned with that in view. As some of the communities may have difficulty in raising funds to carry on this work very rapidly, it is believed that they should be given five years in which to have sewage disposal plants in operation. Legislation should be especially enacted to protect the rivers from acids from steel mills and tanneries, and from tar and amonia from gas plants. There should also be a means of preventing knitting mills from discharging dye into the rivers. The fact that Beloit, Wis., is proposing to discharge its sewage into Rock River in Illinois, immediately below the State line probably to evade Wisconsin laws, prohibiting the discharge into Rock River after a certain fixed time, indicates that Federal legislation should be enacted to control such acts. It may be necessary in the future to prohibit the discharge of oils and greases at garages and oil service stations into the sewers. However if cities are finally required to install plants for treating sewage, they will doubtless pass ordinances regulating the discharge of harmful wastes into their sewers.

Inclo.
Ltr. of W. E. Hyzer, Janesville, Wis.
Ltr. of State Water Survey Division of Illinois.
Report of Dept. of Public Health, Rockford, Ill.

(Signed) C. M. Waters,
Assistant Engineer.

ANNUAL REPORT OF W. G. POTTER, DRAINAGE ENGINEER.

During the fiscal year the following investigations were made by me:

Dams.

Little Rock Creek near Sandwich; Spoon River at Bernadotte; Hickory Creek at New Lenox; Bon Pas Creek at Brown's; DuPage River in DuPage Township, Will Co.; Big Muddy River in W. Frankfort; Crab Orchard Creek near Herrin; Rock River, preliminary study for power dams near Roscoe, Grand de Tour and Camp Grant.

Dredging.

Bell's Landing, Illinois River (see special report); Spring Bay on Illinois River; Crystal Lake; Fox River below Elgin; Rock River at Dixon.

Sanitary Districts and Sewerage.

Taylorville; Itasca; Effingham.

Drainage Districts.

Lorenzo; Mud Creek; Briar Creek; Sangamon River Outlet District.

Grain Elevator at Bell's Landing on the Illinois River.

Channel Dredging at Bell's Landing.

Complaints.

C. B. & Q. near Sepo; C. & I. M. R. R. bridge at Kincaid; Slip D. Chicago River; DesPlaines River dam at Romeo; Cahokia Creek Drainage near Edwardsville.

Bridges.

C. & N. W. R. R. Salt Fork of Sangamon; S. I. & K. R. R. 4, bridges; Penn. R. R. Co., Little Calumet River; Penn. R. R. Co., 3 bridges in Cumberland County; C. B. & Q. R. R., Rock River at Rockford; Cook Co., Highway, DesPlaines River at Milwaukee Ave.; A. T. McIntosh Co., 3 bridges on DuPage River and St. Joseph Creek.

Bridges for Division of Highways.

S. Fork of Sangamon, four bridges; Sangamon N. of Springfield; same E. of Petersburg; Sugar Creek; Hickory Creek at Joliet; Saline River E. of Harrisburg; Baker Creek; Kaskaskia River at New Athens; Coal Creek in Bureau Co.; Edwards River in Henry Co.; Kishwaukee River at Cherry Valley.

Miscellaneous.

Naples levee reconstruction (see special report below); diversion of Cemetery Creek at Mounds; Rockford flood conditions; report on oil pollution in Illinois to U. S. Secretary of State.

Meetings Attended.

National Drainage Congress at Oklahoma City; Illinois Assn. of Drainage and Levee Districts.

* * * * * *

DREDGING AT BELL'S LANDING ON ILLINOIS RIVER

In the fall of 1925 complaints were made that the inlet from the Illinois River to Bell's Landing was so filled up that barges were unable to reach the elevator to load the corn and get it to market. As this elevator is so located that it furnishes the outlet for a large farming territory which has no other way of reaching the market except by trucking a long distance, and as urgent requests were made for dredging, the State decided to do this work in aid of navigation. Consequently a contract was entered into with E. M. Dierksen of Peoria to dredge the channel from the river to the upper end of the landing for $1,000. This was done and the work was completed in time to get the corn crop to market.

* * * * * *

RECONSTRUCTION OF ILLINOIS RIVER LEVEE AT NAPLES.

Naples is a village of about 400 population, located on the east bank of the Illinois River in Scott County. It occupies an area of about 600 acres. In the early days it was practically encircled by a levee along the river front and extending east and north back of the town to high ground. In the high water of 1913 this levee was overtopped and much damage was done.

After the 1913 flood the village made an appropriation of $3,000 and the State appropriated a like sum to rebuild and strengthen the levee. This work was completed and protected the village until the great flood of 1922 when both the river levee and the rear levee were overtopped, and the latter one was broken. In consequence, the village was almost completely inundated and the entire community had to abandon their homes and resort to tents on higher ground. This flood caused great loss and damage. The village was already nearly up to its limit of bonded indebtedness, and again asked the State for aid in rebuilding the levee.

The legislature of 1923 appropriated a sum not to exceed $10,000 to add to the maximum amount that could be raised by the village, to raise and strengthen the levee. This was reappropriated by the legislature of 1925 and the construction was to be in control of the Division of Waterways.

In view of the fact that this levee had been twice overtopped, and in

Naples Levee. Old levee in foreground with grade bar showing height of raised levee.

Naples Levee completed. Same view as preceding picture.

Naples Levee, as completed, showing river at left and protected cornfield at right.

Naples Levee, as reconstructed in 1925.

the light of the studies made by this Division of the probable future high waters, the new levee was built about four feet higher than the crest of the 1922 flood.

Construction was begun under contract by the McWilliams Dredging Company of Chicago, in August, 1925, and the work was completed in November, 1925. The final cost amounted to $10,268.75, of which the village paid $2,250.36, and the State the balance of $8,018.39.

ANNUAL REPORT OF H. C. ALEXANDER, ENGINEER.

PERMIT.

During the fiscal year from July 1, 1925 to June 30, 1926, the Division of Waterways issued permits as follows:

Docks	68
Bridges	67
Dredging	35
Shore Limit Walls	12
Bulkheads	9
Dams	13
Submarine Cables	6
Aerial	11
Water Mains	7
Sewerage Systems & Disposal Plants	43
Drainage Districts	5
Piers	34
Total	310

During the year the Division of Highways, Department of Public Works and Buildings, submitted fifty weekly lists of proposed culverts and bridges in addition to thirty-two special cases where approval by the Division of Waterways was requested.

This Division concerns itself with the question of navigation and the area of opening for the passage of flood waters, while the construction details are under the control of the Division of Highways.

ILLINOIS AND MICHIGAN CANAL.

By John A. Walter, *Auditor and Collector.*

SUMMARY SPECIAL CANAL FUND.

Balance on hand July 1, 1925		$44,213.60
Receipts July 1, 1925 to June 30, 1926	$40,754.86	
Expenditures July 1, 1925 to June 30, 1926	28,324.34	
Receipts over expenditures	$12,430.52	
		12,430.52
Balance on hand July 1, 1926		$56,644.12

RECEIPTS.

July 1, 1925 to June 30, 1926.

90 foot strip, lots and bridge rentals	$15,463.88
Water power rentals	13,295.76
Boat house rentals and level licenses	75.00
Water pipe rentals and miscellaneous	10,337.44
Ice leases	870.00
Certified copies	15.00
Tolls and lockages	697.78
Total	$40,754.86

EXPENDITURES.

July 1, 1925 to June 30, 1926.

From canal appropriation	$28,324.34
From river appropriation	13,220.06

ILLINOIS AND MICHIGAN CANAL EXPENDITURES.

July 1, 1925 to June 30, 1926.

Salary locktenders and officers	$ 9,695.00
Labor payrolls	14,151.00
Repairs	661.55
Maintenance and operation	3,777.24
Equipment	39.55
Total expenditures	$28,324.34

MAINTENANCE NAVIGATION ILLINOIS RIVER EXPENDITURES.

July 1, 1925 to June 30, 1926.

Salary locktenders, collectors and inspectors	$ 5,400.00
Labor pay rolls	3,656.95
Repairs	907.22
Maintenance and operation	1,897.13
Dredging in Illinois River at mouth of Canal	358.76
Dredging at Bell Landing	1,000.00
Total expenditures	$13,220.06

Number of boats running, tolls and lockage collected, and tons transported on the Illinois and Michigan Canal and through Henry and Copperas Creek Locks for period July 1, 1925 to June 30, 1926.

	Copperas Creek	Henry	Joliet	LaSalle	Ottawa	Total
Tolls and lockages	$274.05	$303.12	$109.06	$1.89	$9.66	$697.78
Boats cleared	112	98	33	1	4	248
Ton transported	18,890	16,146				35,036
Passengers	107					107

Statement of the principal articles transported upon the Illinois River, cleared at collector's office at locks, at Henry and Copperas Creek, for the year ending June 30, 1926.

Articles	Measures	Copperas Creek	Henry	Total
Wheat	bushels	82,829	30,653	113,482
Corn	bushels	55,155	124,091	179,246
Oats	bushels	4,000	61,190	65,190
Rye	bushels	500	105	605
Merchandise	pounds	1,324,100		1,324,100

ACTIVITY REPORT.

July 1, 1925 to June 30, 1926.

Receipts increased over previous year $5,177.81 and expenditures decreased $12,309.45, balance on hand June 30, 1926 is $12,430.52 more than on June 30, 1925, and $44,339.84 more than was on hand July 1, 1917 when the Division of Waterways assumed charge.

Tolls and lockage increased $371.18 over previous year, increased in boats cleared was 116, and increase of tonnage transported was 14,055 tons.

Office of Collector of tolls at Ottawa was discontinued, effecting a saving of $1,200.00 per annum.

Twelve new leases for strips of canal reserve and six certified copies of land sale books furnished.

Permit issued to park automobile on canal land near Robinson Street, Chicago, at $5.00 per month.

Four water pipe leases have been discontinued and pipes disconnected which reduced the income $826.40 a year.

No rental has been received from the power plant at Dayton.

Old metal at Bridgeport pumping station has been sold.

Recount made of the Public Service Company poles on canal land between Joliet and Ashland Avenue.

Two small boat houses were removed from canal reserve at Joliet and one at Morris.

Foot inspection made of canal and its reserve from Chicago to end of canal at LaSalle.

Morris Paper Mill installed a sewer across canal near their plant.

Repair work due to the flood of August 8, 1924, was completed so that navigation was opened on September 18, 1925, and the first boat through from Joliet reached the Illinois River on September 20th, and closed for the season on November 24, 1925. In 1926 navigation was opened on June 15th, but the traffic so far this season has been light.

New water gauges have been installed at all the locks, and readings recorded twice daily and every lock gate has been measured and sketches made of each one.

The gates at Copperas Creek lock have been repaired and reinforced and the river gates at LaSalle have been taken out and repaired.

New bridge across canal at Stephen Street, Lemont, was constructed by the Cook County highway department and is now in use, the new sewer across canal at same location was completed by village of Lemont.

Sixteen safety openings were made in the Ottawa aqueduct and nine in the one at LaSalle, each being 9-inch by 2 feet 9 inches, these are to take care of flood or high waters.

During high water the north abutment of Channahon dam washed out and was promptly repaired.

In March thirty-five feet of the culvert at Matchtown, west of Marseilles caved in, and was temporarily repaired at a cost of $1,117.66, it is thought that the temporary repairs will not last longer than the end of the 1926 season.

The bridge at California Avenue has been lowered by the city of Chicago.

Two new lock gates have been installed at lock 10, new waste gate installed near Brandon Bridge and new waste weir and gates constructed west of AuxSable. Refilled the crib at Channahon dam with rocks, and repaired wall of lock 6.

Repaired and installed new three inch deck on barge No. 1.

Dredge boat has been remodeled and it can now be moved from pool to pool without lowering the mast, this has resulted in a considerable saving of time and expense in operating the dredge.

This season so far we have dredged between Marseilles and the river lock at LaSalle and cleared the channel to permit boats with 3-feet 6-inch draft to get through. It is proposed to continue the dredging to Birds Bridge, using the fill to strengthen and build up low places in the banks.

The U. S. dredging outfit cleaned out approaches to, and chamber of the lock at Copperas Creek, also dredged and removed fill at mouth of canal where canal enters the Illinois River, and dredged out the channel of Illinois River at Bells Landing in Fulton County.

PUBLICATIONS FOR DISTRIBUTION BY THE DIVISION OF WATERWAYS.

Issued by the Rivers and Lakes Commission of Illinois 1911-1916.

* * *

BULLETINS.

No. 1 The Conservation of Water Power in the DesPlaines and Illinois Rivers and the Improvement of these Rivers for Navigation—1911.

No. 2 Prospectus of a project for a Deep Waterway and conservation of a natural resources of the State of Illinois, prepared by Lyman E. Cooley —1911.

No. 3 Uses of the Great Lakes—1912.

No. 4* Land Drainage in Illinois, by Robert Isham Randolph—1913.

No. 5 A compilation of money spent by the Government on various Harbors, Rivers and Canals, and the riparian property holders benefited—1912.

No. 6 Argument on behalf of the State of Illinois supporting the prayer of the Sanitary District of Chicago for a permit to take 10,000 cubic feet of water per second from Lake Michigan, by Isham Randolph—1912.

No. 7* The 1912 Flood on the Lower Mississippi, by A. L. Dabney, Consulting Engineer, and "The 1912 Flood in the Ohio and Mississippi Rivers," by H. C. Frankenfeld—1912.

No. 8 Proceedings of the organization meeting of the Association of the Mississippi Valley States for river control—1912.

No. 9 The Illinois Water Power Waterway—1912.

No. 10 The Illinois Waterway—A Guide for Navigators from Lake Michigan to the Mississippi River via the Chicago Sanitary and Ship Canal, the Illinois and Michigan Canal and the Illinois River. Also an Alternate Route via the Illinois and Mississippi Canal—1916. (Fourth edition 1921.)

No. 11* European Harbor Development, by Robert R. McCormick—1912.

No. 12* Common Sense applied to the Inland Waterway Problem, by Robert R. McCormick—1912.

No. 13. The Illinois Waterway, A Review, by Isham Randolph—1912.

No. 14. Water Resources of Illinois—A cooperative report prepared by Rivers and Lakes Commission and A. H. Horton, District Engineer of the United States Geological Survey—1914.

No. 15* The Illinois Waterway—A Project for a waterway of eight feet minimum depth between Lockport and Utica and available for immediate construction—1914.

No. 16 Stream Pollution and Sewage Disposal in Illinois with reference to public Policy and Legislation, by LeRoy K. Sherman—1915.

No. 17* Report of Survey and investigation of La Moine River, with Reference to Flood Control and Navigation.

No. 18* Flood Control for Pecatonica River—1916.

No. 19* Project for a Navigable Waterway from Southern Illinois Coal Fields to Mississippi River—1917.

No. 20* The Illinois Waterway Report with plans and estimates of cost for a deep waterway from Lockport to Utica by way of the DesPlaines and Illinois Rivers, Internal Improvement Commission—1909.

No. 21* Surface Water Supply of Illinois, Internal Improvement Commission—1908—1910.

No. 22 Report and (Plans*) for reclamation of lands subject to overflow in the Kaskaskia River Valley, Illinois—1910—1911. Postage 16 cents.

No. 23 Report upon the prevention of overflow of the Little Wabash and Skillet Fork Rivers—1911. Postage 16 cents.

No. 24 The Illinois River and its Bottom Lands, by Alvord and Burdick—1915* 2nd Edition 1919.

*Map and Profile of Fox River—1915.

Annual reports of Rivers and Lakes Commission 1912*—1913—1914—1915*—1916*

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* On file in office of Division of Waterways, Chicago. Supply for distribution exhausted.

ISSUED BY THE

DIVISION OF WATERWAYS

SUCCESSOR TO RIVERS AND LAKES COMMISSION.

*First annual report—1917-18.

Second Third, Fourth, Fifth, Sixth, Seventh, Eighth and Ninth Annual Reports 1918-26.

Saline River report 1920 (See Third Annual Report).

Inland Waterways and Transportation cost by M. G. Barnes, 1920.

No. 25 Big Muddy River Report 1922—(Also in Fifth annual report).

No. 25½ Floods in Illinois 1922—causes, results and remedies (Also in Fifth Annual Report.)

Pecatonica River report—1924 (See Seventh Annual Report).

Report of the Interstate Harbor Commission of Illinois and Indiana on Harbor and Terminal Development at the State line between Illinois and Indiana and in Chicago Industrial District—1922.

No. 26 Calumet Lake and Chicago-Nickle Plate Agreement—1926.

No. 27 Laws of Illinois relating to Waterways.

No. 28 Lakes to Gulf Waterway—Diversion of waters from Lake Michigan—Boundary Waters Treaty etc.

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* On file in office of Division of Waterways, Chicago. Supply for distribution exhausted.

FOR ANY OF THE FOREGOING PUBLICATIONS, ADDRESS WM. F. MULVIHILL, DIVISION OF WATERWAYS, CHICAGO, ILL.

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TENTH ANNUAL REPORT

OF

STATE WATER SURVEY DIVISION
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DIVISION OF WATERWAYS

OF

THE DEPARTMENT OF PURCHASES AND CONSTRUCTION

July 1, 1926

TO

June 30, 1927

LESLIE SMALL, Director

WILLIAM F. MULVIHILL, Superintendent of Waterways

M. G. BARNES, Chief Engineer

L. D. CORNISH, Asst. Chief Engineer

Chicago Office, 220 S. State St.

[Reprinted from the Tenth Administrative Report. Printed by authority of the State of Illinois.]

357
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1926

TENTH ANNUAL REPORT

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NATURAL HISTORY SURVEY
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WATERWAYS.

Wm. F. Mulvihill,
Supervisor of Illinois Waterway Construction.

This report, being the Tenth Annual Report of the Division of Waterways, covers in outline the work of the division from July 1, 1926, to June 30, 1927.

Under an amendment to the Administrative Code, effective July 1, 1925, the Division of Waterways was transferred from the Department of Public Works and Buildings and became a part of the newly created Department of Purchases and Construction.

EXTENT OF JURISDICTION OF THE DIVISION OF WATERWAYS.

The law confers upon the department the powers, duties and jurisdiction formerly exercised by the Rivers and Lakes Commission, with especial reference to its jurisdiction over all rivers and lakes of the State of Illinois, to prevent pollution thereof or encroachments thereon; the powers and duties of the Illinois Waterway Commission, with reference to the construction, operation and maintenance of the Illinois Waterway, and for the development and utilization of the water power thereof; and also the powers of the Illinois and Michigan Canal Commissioners, for the control and management of the Illinois and Michigan Canal, the maintenance of the navigability thereof and the sale and lease of canal lands and property.

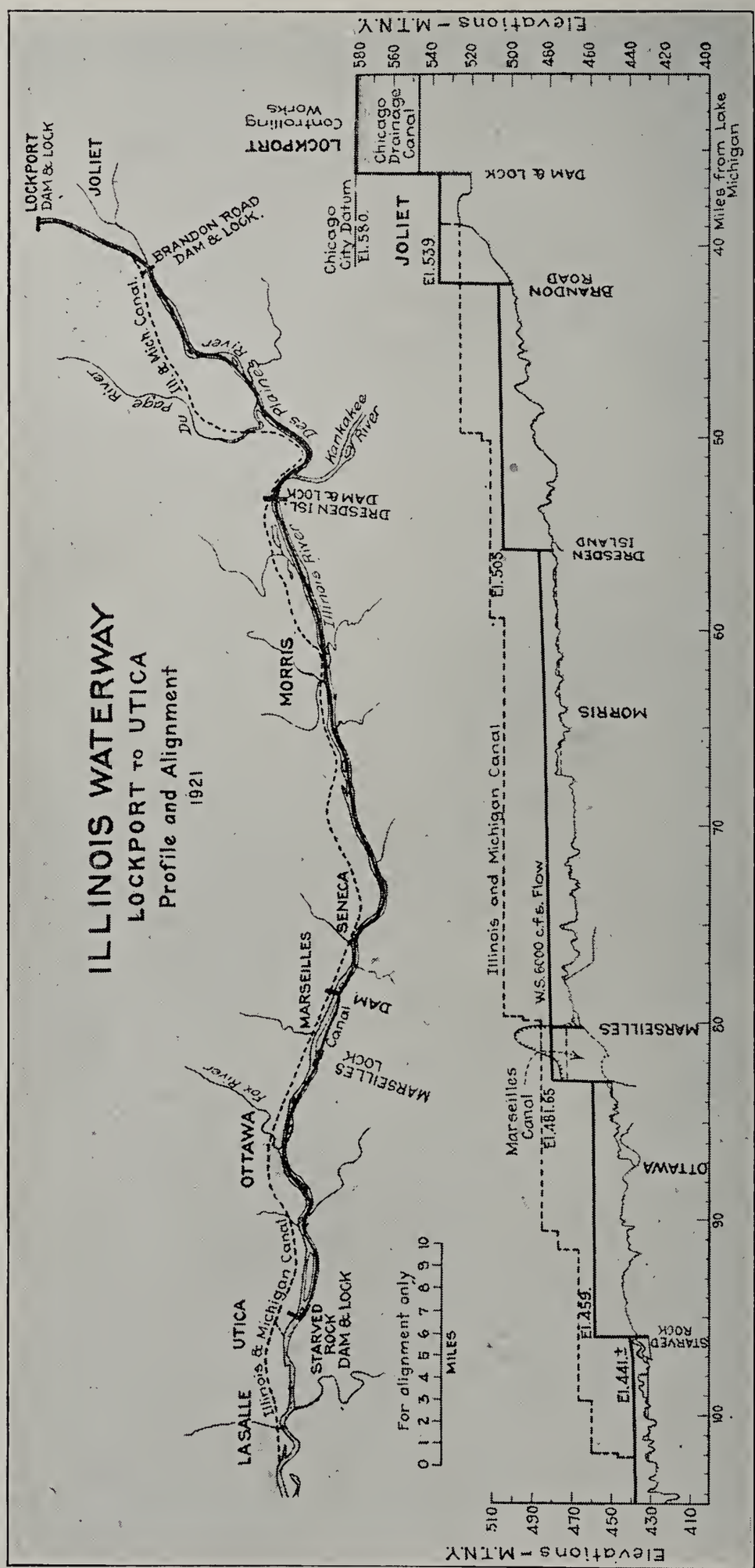
A YEAR OF STRENUOUS WORK.

The fiscal year ending June 30, 1927, was a strenuous one for the Division of Waterways. Although excessive rainfall and adverse weather conditions tended to slow up the construction work of the division, many controversial questions were disposed of and plans worked out for completing the Illinois Waterway in the shortest possible time consistent with economical and satisfactory construction.

Among the many important matters claiming the attention of the division the following are noted here, although some of them will be discussed at greater length in the body of this report:

CHICAGO NICKEL-PLATE—CALUMET LAKE ORDINANCE.

1. Consideration and rejection of application for approval of the so-called Nickel-Plate Calumet Lake contract ordinance on the grounds set forth in a communication to Hon. A. A. Sprague, Commissioner of Public Works, appointed by Mayor Dever, in which seventeen reasons why the permit requested should not issue are detailed. Following this action by the division, the General Assembly repealed the Calumet Harbor Act of 1921, under which the Nickel-Plate ordinance had been



Showing deep waterway now under construction by State of Illinois. Five locks, 110 x 600 feet. With present flow from Lake Michigan, minimum depth in earth will be 9 feet and in rock 11 feet, with 14 feet on miter sills.

passed by the Chicago City Council, and an amendment to the Cities and Villages Act was adopted enlarging the powers of the City of Chicago and other municipalities and providing for the levy of a special tax for purposes of harbor construction.

CHICAGO RIVER STRAIGHTENING PERMIT.

2. As a result of protest of the division, made to Mayor William E. Dever regarding the failure of the city to provide downtown terminal facilities for water-borne traffic in connection with the straightening of the South Branch of the Chicago River, the division finally secured a reservation of space under Wacker Drive for water terminal facilities. While this provision is deemed wholly inadequate and of little value, it was accepted as the best concession obtainable in connection with the issuance of a permit for the proposed river straightening.

3. Completion of contract for construction of Illinois Waterway lock, No. 1 at Lockport, by Green & Sons Company of Chicago.

4. Construction of Illinois and Michigan Canal bridge at Columbus Street, Ottawa.

5. Cancellation of permit for pile bridge over Bubbly Creek at Pershing Road, Chicago, for reported violation of terms thereof.

6. Attendance and participation in waterway conventions of Mississippi Valley Association at St. Louis, November 22-23, and National Rivers and Harbors Congress at Washington, December 8-9.

AIDED DEFENSE IN DIVERSION SUIT IN U. S. COURT.

7. Cooperation with engineers and attorneys of Sanitary District of Chicago and Attorney General of Illinois in preparation and presentation of evidence for the defense in the hearings before Charles Evans Hughes as Special Master for the Supreme Court of the United States in the water diversion litigation of Wisconsin, et al. vs. the State of Illinois, et al.

8. Visitation of Beardstown, Cairo, and other flooded areas and recommending plans for flood relief and protection, including needed legislation.

FLOOD RELIEF ACTIVITIES.

9. Attendance upon the Peoria flood control conference and sessions of the Chicago Flood Control Commission; the preparation of questionnaires and securing of data dealing with extent and damage to Illinois lands and property from floods in Illinois and Mississippi valleys in 1926 and 1927.

10. Securing air-photos of Illinois Valley floods 1926-1927 and data for emergency flood relief legislation.

11. Preparation of Emergency Flood Relief bill, for enactment by Illinois General Assembly.

12. Attendance upon sessions of Fifty-fifth General Assembly which convened January 5, 1927, and adjourned June 30, 1927.

13. Negotiating settlements with owners of lands needed for waterway purposes in the DesPlaines and Illinois valleys.

14. Cooperation with city authorities and civic organizations of Beardstown in securing contributions from Baltimore and Ohio, and Chicago, Burlington & Quincy railroads to supplement legislative appropriations to provide sea wall and levees protecting said city from flood waters of the Illinois River.

"CALUMET HARBOR AND THE NICKEL PLATE ORDINANCE."

An Address, March 1, 1927, before
The South End Chamber of Commerce, Chicago.

By Wm. F. Mulvihill, Superintendent of Waterways.

The invitation to address you tonight on the subject of Calumet Harbor did not indicate the exact purpose, or points, which I should discuss. Permit me therefore to express the hope that if I do not come at once to the consideration of those things which are in your minds most important that you will bear with me, with all patience, while I talk about some things which I consider as of great importance, but which may not at present seem so important to you.

In the first place, let me say that I am deeply interested, as a citizen of Chicago and as Superintendent of Waterways of the State of Illinois, in the development of proper port and harbor facilities in Chicago to meet the anticipated needs of water-borne commerce when the Lakes-to-the-Gulf Waterway shall have been completed and the dream of a deep water connection with the Atlantic ocean shall have been realized.

LAKES-TO-GULF NAVIGATION.

The completion of a 9-foot navigable channel from Chicago to New Orleans, in my opinion is only a few years off. The State has completed, or has under contract, three of the five great locks and dams necessary to unite the waters of the Chicago drainage canal at Lockport with the Illinois River at Utica, which will overcome a fall of 140 feet in a distance of 65 miles, and give a 9-foot channel 102 miles towards the Mississippi from Lake Michigan. The Calumet River and Calumet-Sag Channel connect Lake Calumet with the main channel of the Chicago Sanitary District thus affording you a direct water route from the Calumet district to the trade and commerce of the Mississippi valley system.

This work of building the Illinois Waterway is under my immediate supervision, and will be pushed to completion as rapidly as possible. We estimate three years as the time necessary to complete our construction work, after the last contract is awarded. We are now negotiating for the remaining lock and dam sites and I confidently expect that within three years from next July the State's share of the Lakes-to-Gulf Waterway will be finished.

Our plans are for a 9-foot channel, but improvement of the lower Illinois and Mississippi rivers is under Federal jurisdiction.

FEDERAL AID FOR INLAND WATERWAYS.

When I was appointed Superintendent of Waterways, by Governor Small, September 2, 1925, the Federal projects for the Illinois River between Utica and the Mississippi—a distance of 225 miles with a fall of only 28 feet in the entire distance—called for a navigable depth of only 7 feet, and for but 6 feet in the Mississippi between the mouth of the Illinois and St. Louis.

And so it was that my office, with the approval of the Governor, promoted the inclusion of the Illinois River item in the Rivers and Harbors bill recently passed by Congress, which act modifies the former projects so as to provide for a 9-foot channel instead of 7 feet in the Illinois River from Utica to Grafton and authorized an appropriation of $3,500,000 therefor.

DIVISION OF WATERWAYS AT WASHINGTON.

In passing let me say that the State of Illinois was represented in Washington from January until July last year by Mr. M. G. Barnes, Chief Engineer of my office, who was in almost daily contact with me by wire; and let me further say that a certain gentleman who is claiming to have promoted the action of Congress and the construction work of the Illinois Waterway is strutting about in borrowed plumage—decked out in laurels he has not won and claiming credit not his due.

The fact is that the gentleman referred to has never, up to this hour, appeared before the State Legislature or the Congress of the United States, or before any committee of either the State or Federal governments in aid of the Illinois Waterway or of any movement in behalf of navigation or water-borne commerce.

But the important thing is that the Federal government has taken action to improve the lower Illinois and has directed an engineering report to be made looking to the improvement of the Mississippi to St. Louis and is now improving that river below St. Louis to a 9-foot depth. More than that, the Congress has authorized an appropriation of $3,500,000 to do the work with, which is exactly in line with my thought as to what the City of Chicago should do towards the development of Calumet Harbor.

FACTS REGARDING NICKEL PLATE ORDINANCE.

Although many of you—perhaps most of you—are acquainted, in a general way, with the Calumet-Lake-Nickel Plate railroad ordinance, there may be some who do not understand its provisions and are unacquainted with the legislative history preceding it or my reasons for declining to recommend its approval by the Director of the State Department of Purchases and Construction of which the Division of Waterways is an intergral part.

Let me therefore refresh your memory as to these historical and legal antecedants:

(1) Calumet Lake is a shallow body of water about 3 miles long and 1¼ miles wide, with an area of about 2,000 acres. It lies wholly within the City of Chicago. It is connected at the south end, near One Hundred Twenty-ninth Street with Lake Michigan by the Calumet River, which is 6 miles

long and developed by the Federal government to accommodate vessels of 21-foot draft.

STATE OWNED BED OF LAKE CALUMET.

(2) Under the Constitution and laws of the United States, and the compact in the government ordinance of 1787 the title to the bed of Lake Calumet, as of all other navigable water of Illinois, is in the State in trust for the people. In other words, prior to 1921 the State of Illinois owned the lands under Lake Calumet, in fee.

(3) In 1921 the State Legislature passed an act "in relation to the construction of a deep water harbor in Lake Calumet" and granting the title to certain submerged lands to the City of Chicago—subject to certain conditions. This act authorized the reduction of the area of the lake from 2,000 acres to 500 acres but provided for a depth of about 22 feet of water, so that the total volume of water would be very nearly the same as before.

TITLE TRANSFERRED TO CITY ON CONDITION.

(4) The law also provided for the transfer to the City of the State's title to the bed of the lake, except the reserved water area, and that the acceptance by the city of the grant of lands should obligate the city to build a harbor according to plans to be prepared by the city and approved by the Director of the State Department having jurisdiction.

(5) The city was authorized to sell, convey or lease these lands, with a proviso that before same shall become effective it shall be approved in writing by the Director and the seal of the State department affixed. The law also provides for the creation of a harbor fund consisting of all moneys received from the sale or lease of such lands and to be used only for the purpose provided in the act.

(6) There was also a provision authorizing the Sanitary District of Chicago to build the harbor and to take title to the lands in lieu of the city, under certain conditions.

LAW IN FORCE JULY 1, 1921.

(7) This law which became effective July 1, 1921, had been before the legislature at several sessions and had been killed by vetos or threats of veto by three Governors—Dunne, Deneen and Lowden—previous to Governor Small's approval of it in 1921, after the Attorney General had held it to be constitutional.

(8) June 3, 1922, the Chicago city council voted to accept the grant of State lands, authorized by the statute, and thus obligated the city to construct the harbor according to a plan to be submitted to and approved by the State.

(9) July 13, 1922, C. R. Francis, then Commissioner of Public Works submitted for the city, a tentative plan, which was approved, as stated in the permit, to enable the city to protect its rights in certain pending boundary disputes and to enable the city to prepare a plan for financing the project. It was expressly stipulated that "detailed plans and estimated cost of construction" should be submitted; that land areas should be reduced and water areas enlarged; that the number of slips should be increased and that the beginning of the work should start at the south end of the lake and proceed northward in such units as would permit modification to give better water and rail connections if deemed desirable.

CONDITIONS OF STATE PERMIT DISREGARDED.

(10) None of these conditions were observed by the city—up to September 28, 1925, upon which date the Nickel Plate ordinance was submitted to me for approval by the Director of the department in behalf of the State.

(11) I turned the request over to my engineer department for report. Then it was I first learned that the city had not provided us with the information necessary to an intelligent decision as to whether or not the plan proposed was in harmony with the law and well-calculated to meet the prospective navigation needs intended to be promoted by the State's transfer of title to the lands involved.

(12) Several personal conferences were held with city officials but since the city had failed and continued to fail, to furnish information esteemed necessary, our office was forced to make its own independent investigation of the entire subject, so I was unable to give my answer until January 8, 1926, when I informed A. A. Sprague, the present Commissioner of Public Works, that I could not recommend to the Director the approval of the ordinances and transfer of the land titles; and indicated seventeen reasons therefor.

OBJECTIONS TO NICKEL-PLATE ORDINANCE.

Summarized my objections to the City-Nickel Plate ordinance, more fully stated in my letter of January 8, 1926, are:

1. It provides for an immense railroad yard for the Nickel Plate; but for no harbor.
2. No industrial sites would be created under it.
3. The city offers no plan for financing the creation of industrial sites.
4. No docks are provided for; the deep water channel would be 400 feet from shore.
5. It does not comply with the State's provisional permit issued in 1922 and is not the same plan then submitted.
6. It limits the railroad's obligation for dredging to $600,000 but the dredging to be done by the railroad would cost $737,000 according to the city's estimate and over $1,500,000 on the State's estimate.
7. The city being unable to pay the railroad in cash the cost of the work in excess of $600,000, it would have to pay in land which would give the railroad absolute power to prevent the development of a harbor of any kind.
8. It fixed a price to the railroad of $2,000 per acre for lands which it would cost the city from $3,000 to $4,200 per acre to fill.
9. The boundary line settlement gives the railroad 228 acres as against 284 acres to all other riparian owners combined.
10. The Nickel Plate would get a right-of-way completely surrounding the lake to the exclusion of all other railroads.
11. This Nickel Plate monopoly would probably mean additional switching charges.
12. No information was submitted showing any demand for industrial sites at this location.
13. It is contrary to the spirit of the Van Vlissingen plan, adopted by the City Council in 1921 which contemplated an industrial and commercial harbor, with public ownership or control.
14. The city, though requested to do so, failed to furnish a legal opinion as to the validity of the ordinance, and statute of 1921 and the city's right to favor the railroad over all other riparian owners.
15. The city could not legally grant to the railroad, as a part of its boundary line agreement, lands not adjacent to the boundary lands.
16. It unlawfully sought to deprive the State of supervisory powers created by statute.
17. The Calumet Harbor Act of 1921 authorizes the city to permit the Sanitary District to build the harbor, and allows the latter to create, by special tax an adequate fund to construct the same.

POLITICAL MISREPRESENTATION CHARGED.

In my letter to Commissioner Sprague I stated: "Should you care to discuss the matter further, or to have the original agreements returned, please advise me and I shall arrange accordingly."

I call your attention to the fact that my letter, dated January 8, 1926 and delivered on that date to Commissioner Sprague, remained unacknowledged until March 9, 1926, but in the meantime the Democratic County convention on Sunday, February 7, 1926, as published in a local

paper, made a wholly unjustified attack upon me, as an officer of a State department, charging that refusal of my office to approve the Nickel-Plate ordinance was an "obvious abuse of a power which was obtained from the legislature under conditions savoring of blackmail." The resolutions also declared that "the people of South Chicago with substantial unanimity, indorsed the project because it promised to add wealth to their region."

In view of the resolution adopted by your organization, and by some 12 or 15 other local commercial and civic bodies, asking for the repeal of the Nickel-Plate ordinance, it is perhaps unnecessary for me to defend myself from the charges made for political purposes by the present Democratic City Administration.

NO POLITICS INVOLVED IN ORDINANCE REJECTION.

Let me quote John M. Ewan, Chicago Harbor Commissioner, in his report on the Chicago Dock Problem, of October, 1909, as throwing some light upon the local situation, and as a refutation of the suggestion that the State administration refused approval of the Calumet-Nickel Plate ordinance for political reasons. Mr. Ewan in his report said:

"Railroad ownership of docks affords efficient service, as a rule, for railroad purposes, but railroad-owned docks do not satisfy the needs of a community for facilities for handling traffic not transferred to or from railroad carriers. Where one railroad owns the docks, other railroads are placed at a disadvantage, to the injury of the community at large. Moreover, while railroads encourage connecting ocean traffic, with which rail competition is impossible, they seek to suppress coastwise traffic and inland water transportation. Control of dock facilities is an important aid to the railroads in suppressing competition by water carriers."

TAKES CITY NEARLY A YEAR TO ANSWER LETTER.

On March 9, 1926, one week less than a year ago, Commissioner Sprague and Corporation Counsel Busch wrote me a two page letter, the first paragraph of which reads as follows:

"Referring to your communication dated January 8, 1926, expressing your disapproval of the Lake Calumet-Nickel Plate Railroad ordinance, and indicating seventeen reasons for that disapproval: We have delayed answering in order to thoroughly consider and completely investigate each of the several objections which you have indicated."

This letter failed to answer any of the several objections, but concluded with the following paragraph:

"We are writing you this letter at this time because we feel that you should be apprised of the reasons for the apparent delay in answering your letter of January 8th."

COMMERCIAL CLUBS SEEK ACTION BY CITY.

You will recall from my previous statement that in my letter of January 8, 1926, I suggested to Col. Sprague that if he cared to discuss the matter further or to have me return the original copies of the agreement between the city and the Nickel-Plate Railroad which had been submitted for approval and would advise me of his wishes, I would arrange accordingly.

No request for the return of these documents was made, but on or about September 10th, 1926, a committee representing your organization called upon Mayor Dever and presented resolutions requesting his Honor, the Mayor, to submit the same to the City Council at its next regular meeting on September 15th last, with a request that the council immediately repeal the Nickel Plate ordinance under the State Law of 1921, and requesting further that the City Council prior to January 1, 1927, propose a definite plan for the financing and development of one of Chicago's very greatest commercial and industrial assets, the Calumet Harbor.

A copy of these resolutions was furnished to me and in addition some members of the delegation which waited upon the Mayor, advised me that Mayor Dever had expressed himself as favorable to your petition but was in doubt as to whether or not my office had definitely refused to approve the Nickel Plate ordinance.

Copies of similar resolutions were furnished me as having been adopted by:

1. Roseland Kiwanis Club.
2. Harvey Chamber of Commerce.
3. 119th Street Business Men's Association.
4. 119th Street Commercial Club.
5. North Roseland Improvement Association.
6. West Pullman Lions Club.
7. Kenrose Women's Club.
8. Roseland Lions.
9. South Michigan Avenue Improvement Association.
10. Morgan Park Improvement Association.
11. Garden Homes Improvement Association.
12. 103rd Street Greater Chicago Improvement Association.
13. American Voters' League.
14. Chesterfield Commercial Club.

ORIGINAL DOCUMENTS RETURNED TO CITY.

Acting upon the suggestion of the delegation from your organization, I, on September 13, 1926, returned to the Commissioner of Public Works of the City of Chicago the original signed copies of the proposed contract between the city and the Nickel Plate Railroad with a letter stating the position of this office with regard to the development of a proper harbor in Lake Calumet.

At the time the gentlemen from your organization were in my office, I suggested that if the people of the Calumet region were convinced that the proposed Lake Calumet Nickel Plate ordinance was undesirable and should therefore be repealed, and if the city intended to build the harbor under the State Law of 1921, immediate steps should be taken to finance the project.

ALTERNATIVE PLANS FOR HARBOR SUGGESTED.

I further suggested the desirability of excluding the idea of a harbor belt line completely surrounding the lake and that in lieu thereof railroad connections for all the lands and slips on the west side of the lake be made with the present Pullman Railroad and on the east side of the lake with the Nickel Plate and Chicago and Western Indiana Railroads, both of which connect by existing Belt Lines with all rail-

roads entering Chicago with but a single switching charge, whereas the Harbor Belt would require a double switching charge.

In connection with my letter of January 8, 1926, to the city, attention was called to the fact that terminal railroad facilities were and are available for development of Calumet Harbor without necessity for a Harbor Belt Line and that the existing railroads connect with Trunk Line Railroads both at the north and south end of the lake, which would make it unnecessary to construct a railroad bridge across the entrance to the proposed harbor.

COPIES FURNISHED CITY OFFICIALS.

At that time my office suggested a harbor plan and presented a map, copies of which were furnished to the Mayor and members of the City Council, as a substitute for the Nickel Plate Railroad plan.

If the alternative plan submitted or some modification of it should be adopted the first section of the harbor at the southwest corner of the lake containing about 102 acres and immediately adjacent to the improved channel of the outlet of Calumet Lake could be filled and reclaimed and suitable docks placed in front of the entire tract for a distance of about 4,300 lineal feet, together with the filling for both railroad and highway purposes, as shown on plan, for an estimated cost of about $743,500.

BENEFITS OF PROPOSAL EXPLAINED.

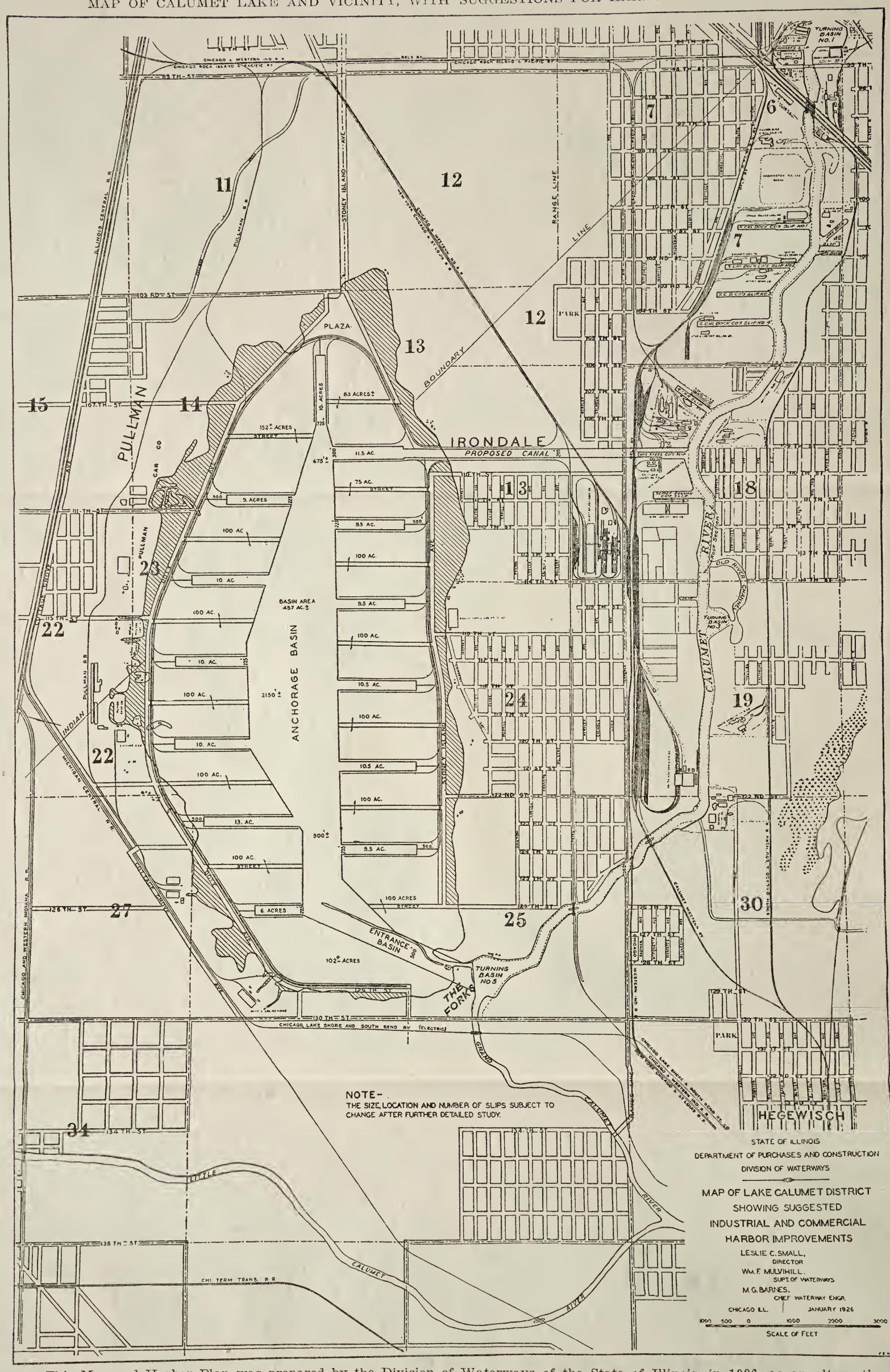
If this plan was adopted, the existing terminal railroads, which now serve lands adjoining this property, could serve the proposed dock property without cost to the city. The cost of filling this 102 acre tract, building the docks and filling in Doty Avenue, from the entrance basin to about 126th Street, would cost nearly $200,000 less than the city would have to pay under the Nickel Plate ordinance for digging a 200-foot trench up through the middle of the lake. And the city would have available 102 acres of developed harbor lands, provided with suitable docks, ready for immediate occupancy and connected to the present Federal channel with a depth of 22 feet suitable to accommodate all lake traffic.

If the work should be done in sections as thus suggested, it would greatly reduce the length of haul of the excavated material, as compared with the Nickel Plate plan, at an estimated saving of 15 cents per cubic yard. On the basis of the city's estimate of the amount of fill required for this area, the saving would amount to $328,000. Moreover, the city would have the benefit of the filling for street or highway purposes and would still own the railroad right-of-way which it might lease or sell, if it so desired.

REVOLVING FUND PROPOSED.

I suggested to your committee that as an evidence of the good faith of the city administration, provision should be made for an adequate revolving fund to enable the city, after repeal of the Nickel Plate ordinance, to proceed with the construction of Calumet Harbor along the lines suggested by our office or on some other basis which might be deemed more desirable by yourselves and the city.

MAP OF CALUMET LAKE AND VICINITY, WITH SUGGESTIONS FOR HARBOR DEVELOPMENT.



This Map and Harbor Plan was prepared by the Division of Waterways of the State of Illinois, in 1926, as an alternative to the then pending "Nickel Plate" ordinance. It shows how terminal railroad facilities now available could be utilized. These terminal roads connect with trunk line railroads at both ends of the lake, thus making unnecessary a railroad bridge across the entrance to the harbor. This plan would also save the additional switching charge which a "belt line" around the lake would entail.

I suggested three possible plans for consideration by your committee as feasible and practical methods of procedure, as follows:

First, that the City Council include in its 1927 budget an appropriation of not less than $1,000,000 nor more than $2,000,000 as a revolving fund for Calumet Harbor Construction.

Second, that if an outright appropriation could not be secured from the Mayor and City Council, a bond issue for not less than $2,000,000 be submitted to popular vote at the February Aldermanic primary, if possible, and not later than the April election, which if approved would provide funds for your needs, and

Third, that if such bond issue was submitted and not approved, then an appeal could be made to the Legislature now in session and which does not adjourn until the first of July, asking that the Calumet Harbor Act of 1921 be repealed and that a new law be enacted authorizing the creation by vote of the people of a Calumet Harbor District on which should be conferred the same powers, rights and privileges with regard to the ownership lease or sale of Calumet Harbor lands as were sought to be conveyed to the city by the Act of 1921.

I understand that the representatives of your organization have been unable to secure from the present Mayor and City Council any action looking even to the repeal of the Nickel Plate ordinance to say nothing about their making any other provision for the development of your greatly desired harbor.

NO ACTION TAKEN BY CITY.

Sometime after the delivery of the above address at the solicitation of the business interests of Calumet District, and prior to the change in the City Administration, this office agreed to recommend the issuance of a permit for construction of the proposed harbor by the city itself under certain conditions, which were not complied with and all negotiations lapsed.

CALUMET HARBOR ACT REPEALED.

Because it was feared that the Lake Calumet Harbor Act of 1921 was unconstitutional a substitute measure was introduced in the General Assembly by Representative Wm. W. Powers of the Thirteenth Senatorial District at the request of the new City Administration of Chicago.

The proposed House bill, which eliminated all State supervision, was unsatisfactory to the Superintendent of Waterways and died on the Speaker's table.

After discussing the matter with Representatives Powers, Garriott and Schnackenberg and Senator Harry Starr, all of the Thirteenth District, the Superintendent of Waterways, in conference with Corporation Counsel Samuel Ettelson and his assistants, proposed that the desirable features of the Powers bill and of the 1921 Harbor Act, together with certain reservations of State supervision, be added as amendments to Senate Bill 611, then pending, in order that a proper Harbor Act might be enacted without delay.

The new Act gives the city the power to levy a special tax for harbor construction. While it prohibits the sale of harbor lands, it permits the city to lease the same for 50 years, rentals to be based upon a revaluation every ten years.

Originally the amended Senate bill was a so-called "city revenue bill" of no particular significance, but having been passed by the Senate, it afforded a means of establishing the desired basis for harbor construction. The House adopted the agreed amendments, which gave a real meaning to the bill, on the next to the last day of the session and passed the bill as amended about 10 o'clock on the night of adjournment.

Active cooperation between representatives of the city and of the Division of Waterways resulted in the Senate concurring in the House amendments as the last act of that body before midnight. That much credit should be given to Senator Harry W. Starr, Chairman of the Senate Harbor Committee, who secured this action by the Senate, will be conceded, when it is understood that the upper house had killed five bills just before the new Harbor bill was voted upon.

The new law gives the city a free hand with reference to harbor development in Lake Calumet and elsewhere in the city. Under it the city can make an arrangement with the Nickel Plate Railroad if it so desires or it can build a harbor itself without reference to the wishes of any railroad or private interest.

CHICAGO RIVER STRAIGHTENING PERMIT.

The question of straightening the South Branch of the Chicago River, as a means of relieving traffic congestion in the down-town district by providing more through streets, has been discussed in Chicago for many years. When the Union Station ordinance was passed, early in 1914 serious consideration was given this question and a provision included under which the railroads, entering the Union Station and owning property abutting on the river, agreed to cooperate with the city, or any governmental agency, in proceeding to straighten the river and also to abide by the decision of a Board of Arbitration regarding all questions of benefits and damages in connection with such straightening.

The Baltimore and Ohio Chicago Terminal Railroad, which owns a large area of land abutting on the river agreed, through the acceptance of an ordinance passed by the City Council on February 19, 1915, to a provision for river straightening similar to the provision contained in the Union Station ordinance.

In August, 1921, representatives of the railroads appointed a committee to study the question. After several meetings of this committee, certain of the railroads undertook to prepare plans for a new union passenger terminal station, south of the loop district, and for new freight facilities in connection with river straightening.

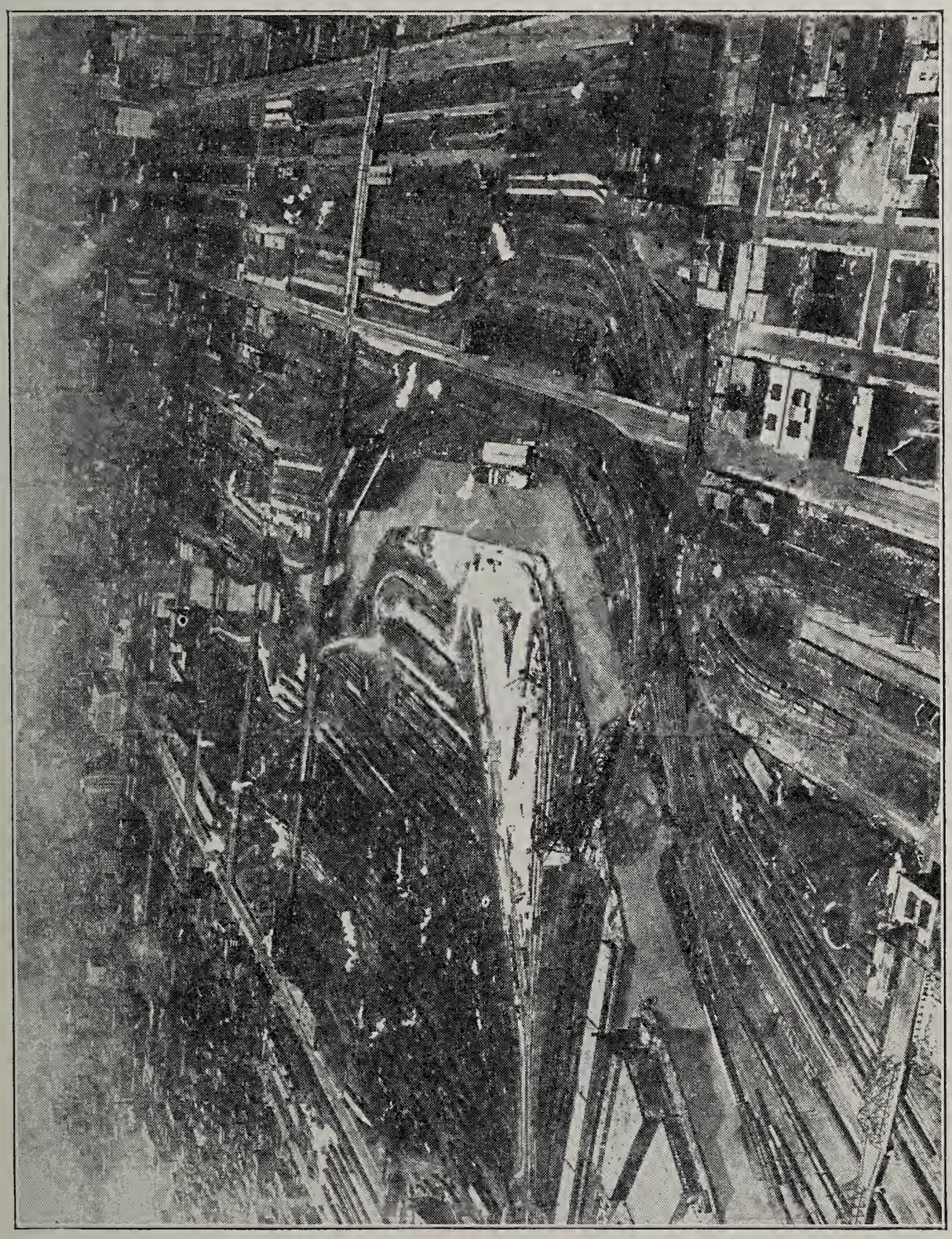
CITIZEN'S COMMITTEE FORMED.

It soon became apparent that river straightening could proceed, without waiting until the character of railroad development should be finally determined, if a satisfactory re-allocation of lands among the several railroads should be agreed upon.

Under these conditions a Citizens Committee consisting of: Silas H. Strawn, James Simpson, Theodore W. Robinson, Arthur G. Leonard,

and William R. Dawes was agreed upon to undertake the work of ironing out the difficulties and speeding up the project.

The project itself was intended not only to provide facilities or benefits to the railroads having terminals south of the loop district,



Airplane view of South Branch of Chicago River, showing how bend interferes with through streets.

but also to open up the whole South Side of Chicago, west of State Street, and the whole West Side from Roosevelt Road to Fifty-ninth Street as well. Dearborn, LaSalle, Wells, Franklin and Canal Streets, now cut off by the bend in the river, will become through avenues of communication north and south. Sixteenth Street and Twenty-second

Street will also be opened across town, affording passage east and west between Roosevelt Road and Thirty-ninth Street.

STATE SOUGHT PROVISION FOR WATER TERMINALS.

While these matters were under consideration, the late William L. Sackett, then Superintendent of Waterways, and M. G. Barnes, Chief Engineer and head of the Division for several months following Mr. Sackett's death, suggested that any plan adopted should provide water terminal facilities to accommodate the downtown commercial interests of Chicago. They urged that, in carrying out the river straightening project and re-allocation of lands to the railroads, provision should be made for a public water terminal for packet freight. These suggestions were based upon the legal proposition that the State owns the bed of all navigable streams in fee, holding the same in trust for the people; and also upon the following statutory provision regarding any change in the location of any such channel:

> "The State of Illinois shall take the same title and to the same extent in territory in metes and bounds in and to the channel course or bed of such watercourse or stream after its relocation by the city or village as it had in the channel course or bed of the watercourse or stream before its relocation."

CITY AUTHORITIES FAILED TO REPLY.

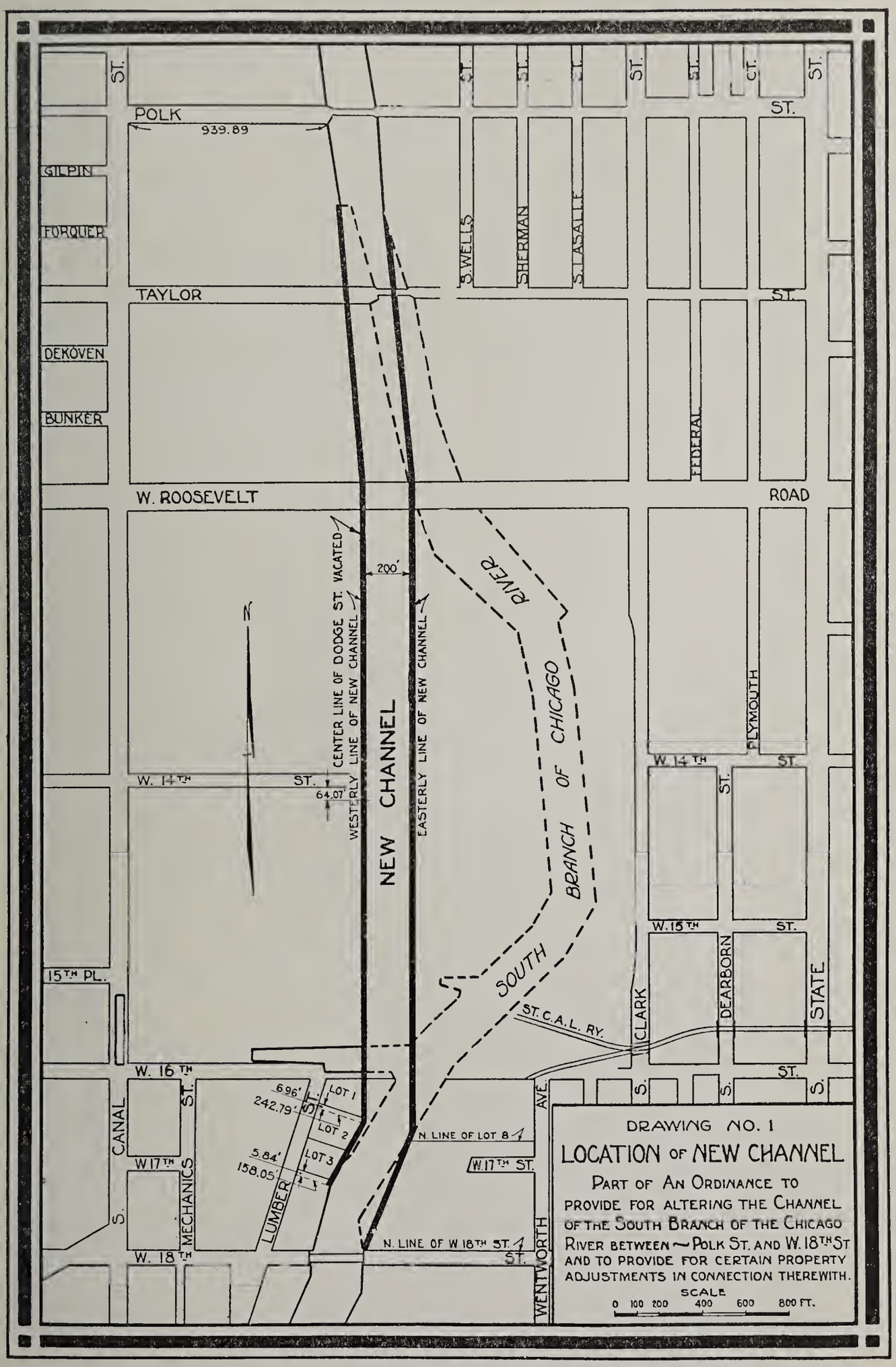
Since it was proposed to make the new river the same width as the old and the distance shorter there would not be the same superficial area, the difference being about 143,370 square feet, it was thought not unjust to require that some provision be made for a water terminal close to the commercial center of the city, whereby the State would receive in terminal area a space corresponding to its lost area in the shortened bed of the river. These requests, addressed to the city authorities, went unanswered.

On July 8, 1926, the Chicago City Council adopted an ordinance entitled "An ordinance to provide for altering the channel of the South Branch of the Chicago River between Polk Street and West Eighteenth Street and to provide for certain property adjustments in connection therewith." (See map herewith.)

ORDINANCE SILENT: MAYOR OFFERS COMPROMISE.

Under date of July 9th the Commissioner of Public Works applied for a permit, to be issued to the City of Chicago or its agent, to proceed with the work covered by the above entitled ordinance, copy of which was furnished on July 14th. The ordinance, a printed book of 218 pages, supplemented by numerous maps and diagrams, did not provide facilities for water-borne commerce suggested in the letters of Messrs. Sackett and Barnes dated April 24, 1924, and July 29, 1925, respectively. This fact was called to the attention of the Mayor.

Under date of July 19, 1926, Mayor Wm. E. Dever, in a letter to the Superintendent of Waterways, acknowledged the failure of the Commissioner of Public Works to answer the letters of Messrs. Sackett and Barnes. He discussed at length the importance to the public of the proposed river straightening and suggested the use of the river


DRAWING NO. 1
LOCATION OF NEW CHANNEL
PART OF AN ORDINANCE TO PROVIDE FOR ALTERING THE CHANNEL OF THE SOUTH BRANCH OF THE CHICAGO RIVER BETWEEN POLK ST. AND W. 18TH ST. AND TO PROVIDE FOR CERTAIN PROPERTY ADJUSTMENTS IN CONNECTION THEREWITH.
SCALE
0 100 200 400 600 800 FT.
POLK
939.89
GILPIN
FORQUER
TAYLOR
DEKOVEN
BUNKER
W. ROOSEVELT
ROAD
S. WELLS
SHERMAN
S. LASALLE
FEDERAL
PLYMOUTH
CENTER LINE OF DODGE ST. VACATED
200'
NEW CHANNEL
WESTERLY LINE OF NEW CHANNEL
EASTERLY LINE OF NEW CHANNEL
SOUTH BRANCH OF CHICAGO RIVER
W. 14TH ST.
64.07'
W. 14TH ST.
W. 15TH ST.
15TH PL.
ST. C.A.L. RY.
CLARK
DEARBORN
STATE
W. 16TH ST.
CANAL
W. 17TH ST.
MECHANICS
LUMBER
6.96'
242.79'
LOT 1
LOT 2
LOT 3
5.84'
158.05'
N. LINE OF LOT 8
W. 17TH ST.
N. LINE OF W. 18TH ST.
W. 18TH ST.
WENTWORTH AVE.

front along the Wacker Drive improvement for water terminal use. Among other representations made by the Mayor were the following:

EXCERPTS FROM MAYOR DEVER'S LETTER.

The Wacker Drive improvement as it has been and is being constructed provides on the lower or dock level for the following marine landing facilities:

1. It has continuous wharfage between Michigan Avenue Bridge and the Lake Street Bridge, a distance of nearly three-quarters of a mile. The actual length of wharfage, deducting bridge abutments, is about 2,725 lineal feet.

2. The dock area for marine landing amounts to 63,690 square feet.

3. The dock level in the east plaza—State Street to Michigan Avenue—provides storage area such as is required in marine transit houses. The total floor space at dock level amounts to 65,400 square feet. There is also storage space available on the dock level between Lake Street and Franklin Street amounting to 6,000 square feet. The total storage area under cover is 71,400 square feet. Total landing area is 63,690 square feet, making a total area for marine landing and storage of 135,090 square feet.

OFFERS BARGE LANDING UNDER WACKER DRIVE.

Transport facilities for serving public barge landing and transit warehouse storage on the low level of Wacker Drive could not be excelled anywhere in the central business district for the following reasons:

1. Continuous wharfage between Lake Street and Michigan Avenue will afford ample room for the docking of barges. There is room for the docking at one time of as many as twenty-four barges 100 feet long, or eighteen barges 120 feet long, or seven barges from 250 to 300 feet long—the latter being the longest barge used on the Mississippi River.

2. There are 63,000 square feet of landing space adjacent to a by-pass thoroughfare around the loop, having a capacity for three lanes of traffic in each direction. This thoroughfare connects with the Chicago and North Western terminals north of the river and east of Michigan Avenue by way of the low level of the Michigan Avenue bridge; with the Illinois Central and Michigan Central freight terminals south of the river and east of Michigan Avenue by way of River Street and South Water Street; with the freight terminal district north of Lake Street on the west side of the river by way of the ramp between Franklin and Lake streets, and with the south side and west side freight districts by way of Franklin to Lake Street ramp and the inclined driveway in Market Street between Lake and Randolph Streets. Connections will also be made for local delivery in the central business district by way of mid-block connections between Michigan Avenue and State Street, State Street and Wabash Avenue, Dearborn Street and Clark Street, and Wells Street and Franklin Street.

"MEETS ALL REQUIREMENTS OF DOWN TOWN SECTION."

3. There are 14,190 square feet of landing space on a frontage of 540 feet opposite storage space of 65,400 square feet with a continuous free way for trucking between wharfage and storage. It would appear that all requirements for a public barge station for the downtown district are fulfilled in the State Street to Michigan Avenue plaza sector. It should afford ample facilities for local delivery in the loop district.

4. Backing-in space, or loading space, is available along the south line of the street from Michigan Avenue to Lake Street. The depth of the space for the major part of the distance is 45 feet, and there is room for the storage of 300 motor trucks.

5. The construction makes possible provision for marine landing and transit storage on the low level of this improvement, and the designating of

certain parts of the continuous wharfage for public landings, also portions of the covered storage space for public use.

6. The dock level is 135 feet wide and is to be used principally for heavy vehicles—motor trucks—offering a valuable by-pass thoroughfare around the loop, so as to decrease or largely eliminate unnecessary vehicle trucking across the loop, especially from the Illinois Central, Michigan Central, and lake front freight stations.

7. Ten entrances to the low level will ultimately be provided along the improvement, giving splendid access for truck and motor vehicle transit for local district freight delivery in connection with marine landing and storage.

8. In addition to this it is perfectly feasible and possible to make a connection with the Illinois Tunnel Company and thus give to this location direct connection with every railroad entering or leaving the City of Chicago.

I think you will agree that the lower dock level of the Wacker Drive improvement will furnish all the marine landing and storage area which can at the present time be forseen as necessary to meet the development which is likely to follow completion of the Illinois Waterway project. When that project is completed there surely will be no insuperable difficulty to the establishing by purchase or condemnation of the necessary river frontage such further public docks as may be required.

PERMIT ISSUED WITH RESERVATIONS.

Under date of August 7, 1926, the following communication was sent to Mayor Dever:

STATE OF ILLINOIS

DEPARTMENT OF PURCHASES AND CONSTRUCTION

DIVISION OF WATERWAYS

Wm. F. Mulvihill,
Superintendent

CHICAGO OFFICE
Chicago, Illinois

Leslie Small, Director

M. G. Barnes,
Chief Engineer

August 7, 1926.

Honorable William E. Dever, Mayor,
City Hall,
Chicago, Ill.

My dear Mr. Mayor:

Referring to your letter of July 19th requesting approval of the so-called Chicago River-Straightening Ordinance, passed by the City Council July 8, 1926, in which letter you indicate in detail the available docking and storage space beneath Wacker Drive.

You are advised that upon receiving a favorable report of our Engineering Department; and upon condition that the City of Chicago will reserve for navigation purposes the space indicated in your letter, I have caused to be prepared a formal permit of the State Department of Purchases and Construction, authorizing the changes provided for in said ordinance and have recommended the approval and issuance of such permit by the Honorable Leslie Small, Director of the Department.

Permit me to say that there are certain provisions of the ordinance which do not have the full approval of our engineers and which, in our opinion, might have been modified and improved without added cost or delay, had your department of Public Works submitted the proposed plans to

our office informally, prior to the adoption of the ordinance in final form by the City Council and the adjournment of that body for the summer.

However, in the hope that prompt approval of the River-Straightening Ordinance by the State will lead to an equally prompt acceptance of its terms by the various railroads; and to the end that always there may be the closest cooperation between the municipal and State governments in matters affecting the public interest, we have decided to waive all minor objections and to recommend immediate approval of the ordinance on the conditions indicated above.

Yours very truly,
(Signed) WM. F. MULVIHILL,
Superintendent of Waterways.

TEXT OF SPECIAL STIPULATION.

The formal permit of the State of Illinois (No. 1179) issued to the City of Chicago "to alter the channel of the South Branch of the Chicago River between Polk Street and West Eighteenth Street in accordance with an ordinance passed by the City Council of the City of Chicago, July 8, 1926, and in accordance with plans filed with the Department of Purchases and Construction," contains the following special stipulation:

"The City of Chicago shall reserve for navigation terminal purposes the space on the dock level of its Wacker Drive improvement, as specifically set forth and described in a letter addressed to the Superintendent of Waterways, dated July 19, 1926, and signed by Wm. E. Dever, Mayor, and shall not lease any of the said reserved terminal area for other than navigation purposes without the consent in writing of the State of Illinois, acting by and through its Department of Purchases and Construction, or other proper agency."

CITY ACCEPTS CONDITIONAL PERMIT.

Under date of August 19, 1926, the City of Chicago by its proper officials thereto duly authorized, accepted the permit subject to all the conditions named therein.

The following letter is self-explanatory:

WILLIAM E. DEVER
Mayor

(Seal)

Office of the Mayor
CITY OF CHICAGO

August 19, 1926.

Mr. William F. Mulvihill,
Superintendent of Waterways,
Department of Purchases and Construction,
Chicago, Illinois.

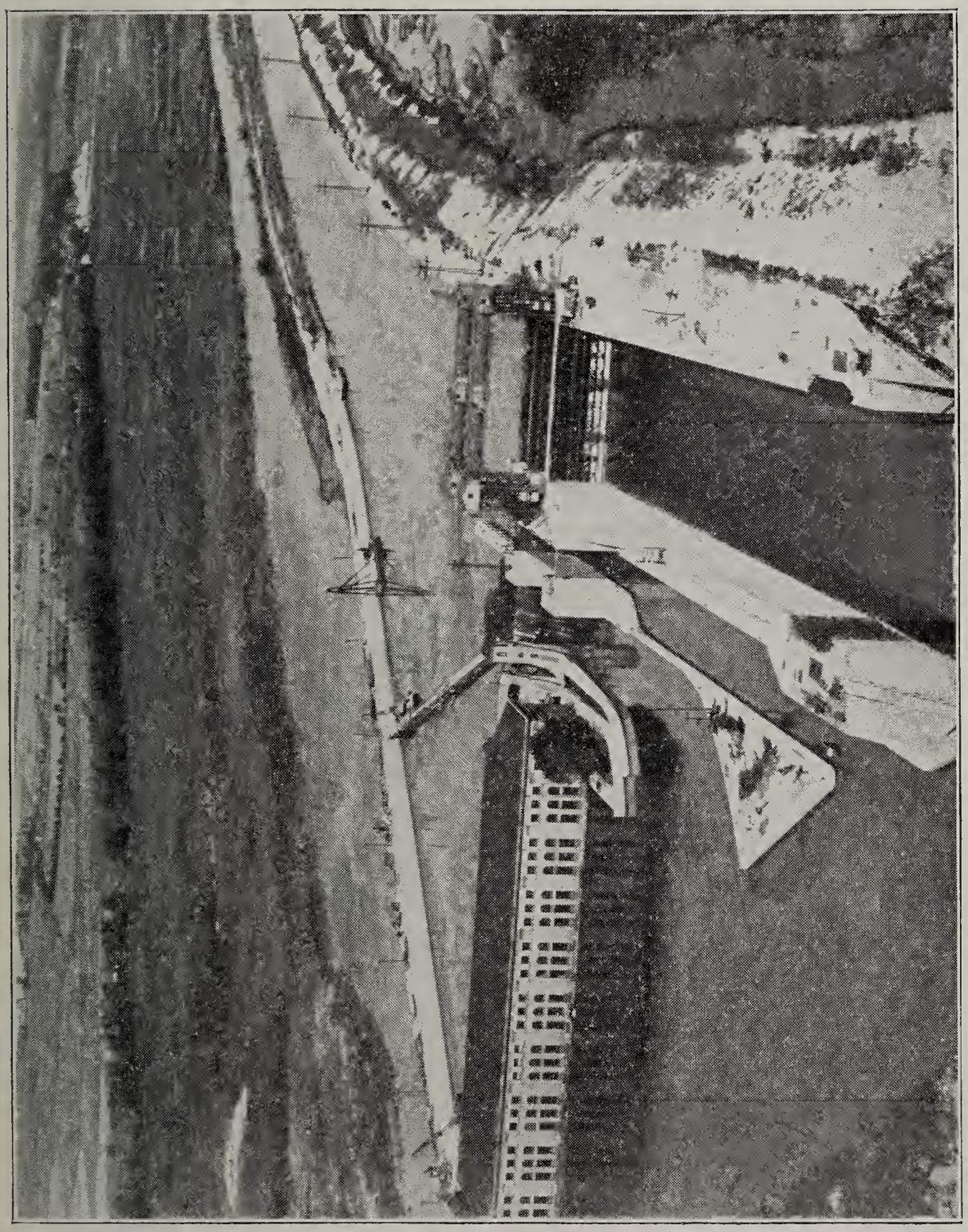
Dear Mr. Mulvihill:

I return herewith Acceptance Blank which was attached to the permit issued by the Department of Purchases and Construction for the proposed straightening of the Chicago River between Polk Street and West Eighteenth Street, in accordance with an ordinance passed by the City Council, July 8, 1926, properly executed by the duly authorized city officials.

Again expressing my appreciation to you for your promptness in cooperating with us in this most important undertaking, I am

Very truly yours,
(Signed) WILLIAM E. DEVER,
Mayor."

(Received Aug. 23, 1926, Division of Waterways, Wm. F. Mulvihill, Superintendent.)



Airplane view of Lockport Lock, No. 1 in the 5 of the Lockport-Utica series of the Illinois Waterway. This lock, like all others of the Waterway, is 110 feet wide and has a usable length of 600 feet with 14 feet of water over the miter sills. It connects the Chicago Sanitary and Ship Canal, which has the same water level as Lake Michigan, with the DesPlaines River 41 feet below. It is 35 miles from Chicago. The old Illinois and Michigan Canal lock is seen to the immediate left of the new lock. Power house at extreme left.

COMPLETION OF LOCK NO. 1.

Lock No. 1 of the Illinois Waterway is located at Lockport about 35 miles from Lake Michigan at the west end of the main channel of the Chicago Sanitary and Ship Canal. This lock is supplied with water from the Chicago Sanitary District Channel and discharges into the DesPlaines River. Like the four other locks of the series between Lockport and Utica, Lock No. 1 has a usable length of 600 feet. It is 110 feet wide with a depth of 14 feet of water at all times. There is a difference of 41 feet between the water levels of the pools connected by this gigantic lock.

This lock is equipped at the upper end with two sets of gates of the submersible type, each weighing 200 tons, the erection of which was included in the general contract for the construction of the concrete walls of the lock chamber.

On October 8, 1923, the contract for construction of this lock, including the upper gates, was awarded to Green & Sons Company, Tower Building, Chicago, the low bidder, at the bid price of $1,460,076.50. Work started immediately, with substantially the same organization that had previously built the Marseilles Lock. The work covered by this contract was completed during this fiscal year at a cost of $1,353,907.83 being $106,168.67 under the contract price.

The gates at the lower end of the Lockport Lock are of the swinging type, each gate being 55 feet wide and nearly 65 feet high. They weigh 315 tons each. The contract for the lower gates of this lock were included with the contract for erection of both the upper and the lower lock gates of the Marseilles Lock.

FLOODS IN ILLINOIS.

Floods in the State of Illinois are not uncommon. Since 1879 there have been more than a dozen floods in the Illinois Valley. Floods causing excessive property damage occurred on the Illinois and Mississippi and their tributaries in Illinois in 1922, 1926 and 1927.

The extent of floods causing damage in 1926-1927 was as follows: Illinois River from Peoria to Grafton, Sangamon River from Springfield to its mouth, Mississippi River from East St. Louis to Cairo.

DURATION OF FLOODS.

The 1926 flood on the Sangamon and Illinois rivers occurred during the crop season and exceeded all prior floods as to flood heights and damage to property. It continued for a period of 42 days on the Sangamon River and for 66 days on the Illinois River.

The 1927 flood followed close upon the flood of 1926 and continued for a period of 109 days on the Sangamon River and for 151 days on the Illinois River, for 33 days on the Mississippi River at East St. Louis and for 75 days at Cairo.

DEPTH OF WATER ON FLOODED LAND.

The depth of water on drainage and levee district land in some cases was as great as 15 feet. In the city of Beardstown on the Illinois

River, 80 per cent of the city was submerged up to a maximum of about 12 feet.

The 1922 flood on the Illinois River had set the highest record since 1844, but new records were established by the 1926 flood. The 1927 flood was practically the same in flood heights as was the 1922 flood.

CAUSES OF FLOODS.

The cause of these floods was excessive rain fall upon the head waters of the streams concerned, which in the case of the Illinois River was unusually excessive for such a small area. The volume of flood waters according to government records was not greatly in excess of previous floods but the construction of levees for the reclamation of overflowed areas had greatly reduced the flood flow section of the rivers which resulted in unusual flood heights for the volume of water discharged. The effect of levees and channel control work also affected to some extent the flood heights on the Mississippi River from East St. Louis to Cairo.

THE CHARACTER OF AREAS FLOODED.

The principal areas flooded consisted of farm lands which had been reclaimed by levees. These reclaimed lands were very productive. When first put in cultivation the crop is confined almost entirely of corn, the yield being from 80 to 100 bushels per acre. In the course of perhaps 10 years, the yield is reduced to about 60 bushels of corn per acre. The yield of wheat ordinarily runs from 30 to 40 bushels per acre.

TOWNS AND CITIES FLOODED.

The cities of East Peoria, Naples, Beardstown and Mounds were the ones which suffered the greatest damage from these floods. Other municipalities wholly or partly under water were Liverpool, Browning, Frederick, Meredosia and Valley City.

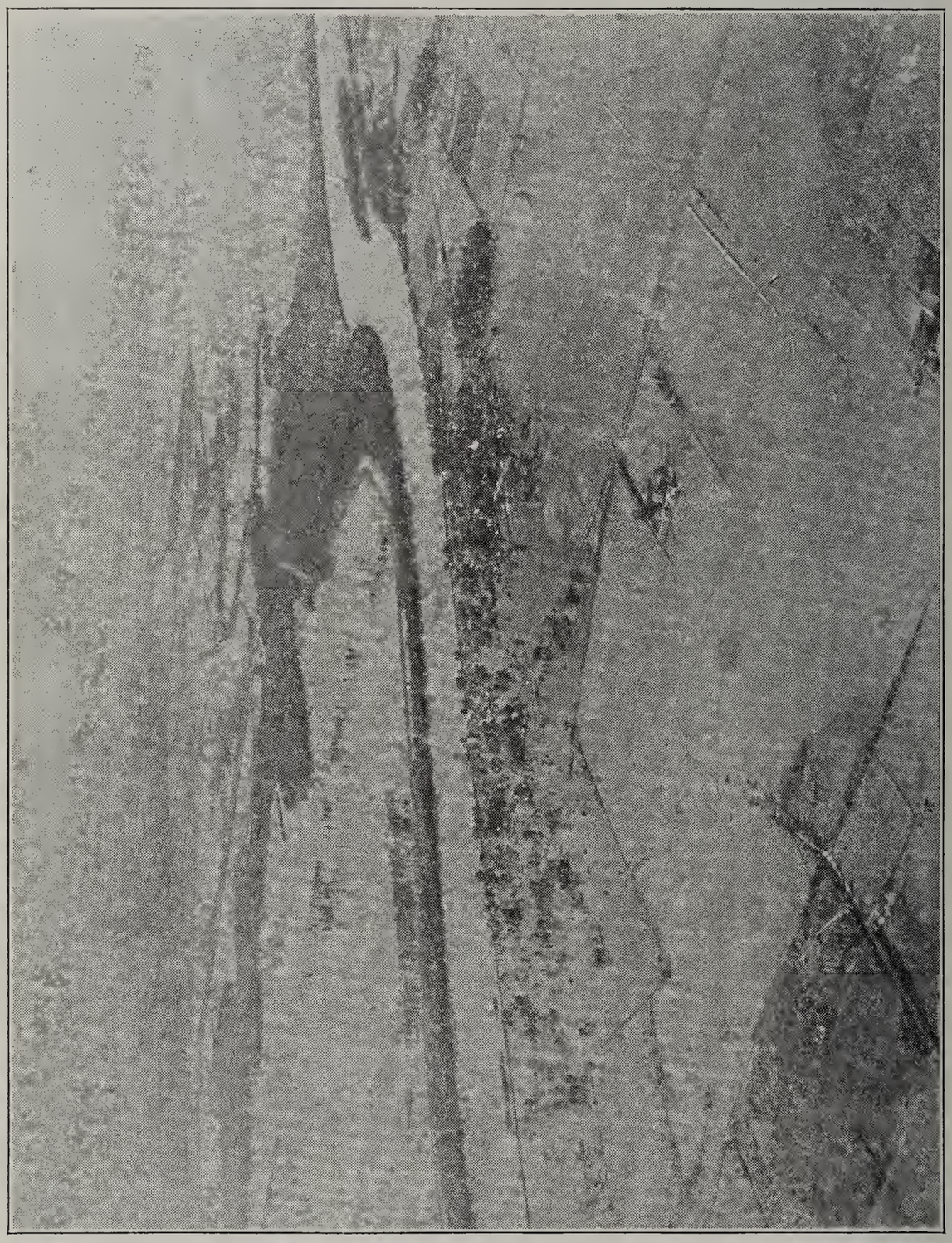
POPULATION.

The population of the flooded areas in Illinois was almost entirely white except in the vicinity of Cairo. In Beardstown the workers residing in the suburbs were compelled to leave their homes, but in Mounds more than one-half of the population were compelled to leave the city for a period of four weeks during the 1927 flood. Those that were forced to evacuate were cared for in other houses and tents on higher ground. There were no lives lost and but few people were injured, none of them seriously. There was no reported increase of sickness which could be attributed to the floods, except at Mounds where a severe out-break of typhoid fever occurred due to flood waters carrying contents of cesspools throughout the city.

AFFECT ON MORALE OF THE PEOPLE.

In the cities of Beardstown and Mounds, which were inundated and also in the city of Cairo, which was saved from destruction by water only through the heroic and efficient work of its citizens, the effect of the floods on the morale of the people was a marked demon-

stration of the fighting spirit of the American pioneer. Everybody turned out and fought the floods so long as there was any possibility of protecting their community and after they were beaten the people exhibited great cheerfulness. Although Beardstown was under water for



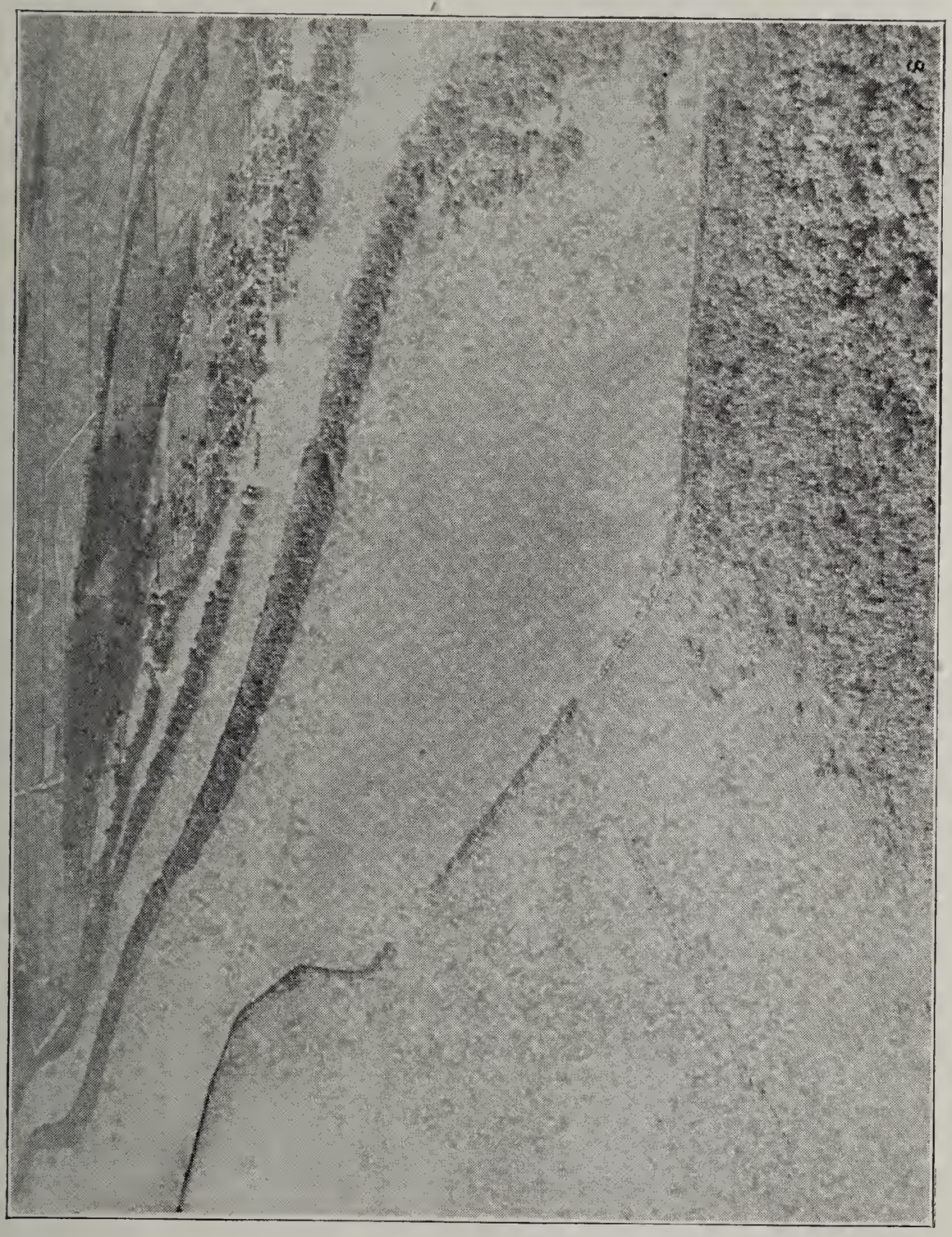
The village of Naples and surrounding farm lands flooded by overflow of the Illinois River.

several weeks in the fall of 1926 and the spring of 1927, business was not suspended. The people got about in row boats or hip high rubber boots.

LOSS AND DAMAGE.

The volume and activity of business in the flooded towns and cities of Illinois is closely related to the prosperity of the agricultural districts which they serve. The effect of the floods on industry was similar to the effect upon agriculture.

Investigations made by this office indicate that damages to 400,000 acres of land in drainage and levee districts, added to the flood loss in cities and to railroads and public property amounted to over $8,000,000 from the flood of 1926 and over $10,000,000 from the flood of 1927. Along the Illinois and Mississippi River valley about 225,000 acres of



Liverpool on the Illinois River showing broken levees and flooded farm lands.

land were under water from two months to two years due to the inability of the local inhabitants to repair their levees, and remove the water by pumps or natural drainage.

EMERGENCY FLOOD RELIEF LAW.

By direction of Governor Small, the Superintendent of Waterways and engineers of this division personally visited Beardstown, Cairo and

other flooded areas for the purpose of securing first hand information as to existing conditions as a basis for recommending plans for flood relief and protection, including needed legislation.

At the request of a Legislative Joint Committee on Flood Relief appointed in response to a special message from Governor Small asking that a conference committee be appointed, the writer undertook to revise and consolidate several flood relief measures which had been introduced by various members of the legislature. This measure carrying an appropriation of $1,500,000 for flood relief and known as Senate Bill 576, (copy of which is included in this report) was enacted into law with but one negative vote.

BEARDSTOWN SEA WALL.

The legislature also reappropriated the sum of $350,000 toward the cost of a sea wall and levee to protect the city of Beardstown from overflow by the Illinois River. This legislative appropriation was supplemented by contributions of $46,000, of which the Chicago, Burlington & Quincy donated $41,000 and the Baltimore and Ohio $5,000, making a grand total of $396,000, which sum was estimated by this office to be sufficient to build a concrete wall along the river front with earth levees connecting the river wall with the high lands back of the city.

FLOOD RELIEF PLANS.

Anticipating the enactment of Senate Bill 576 for Flood Relief in Illinois, the writer on June 27, 1927, advised Mr. L. D. Cornish, Assistant Chief Engineer of the Division of Waterways, that Mr. M. G. Barnes, Chief Engineer, had found himself unequal to the task of looking after the Flood Relief work in addition to his other duties in connection with the Illinois Waterway project and that with the approval of the Director, Mr. Cornish would be in engineering charge of all such work including the construction of the sea wall and levee at Beardstown.

Mr. Cornish was informed that in carrying out this work it would be necessary for him to depend largely upon a special force of employees for work in the field, but that he would be at liberty to call to his assistance members of the regular force who might be in possession of special information or when they could be of particular service, with the understanding, however, that this was to be done with as little interference as possible with the regular work of such engineers and employees.

In connection with the levee repair work a report was asked for covering the entire work to be accomplished, divided into primary and secondary classifications with separate estimates as to the probable cost of both classes of work.

RULES GOVERNING RELIEF WORK.

In this connection, the following rules were laid down:

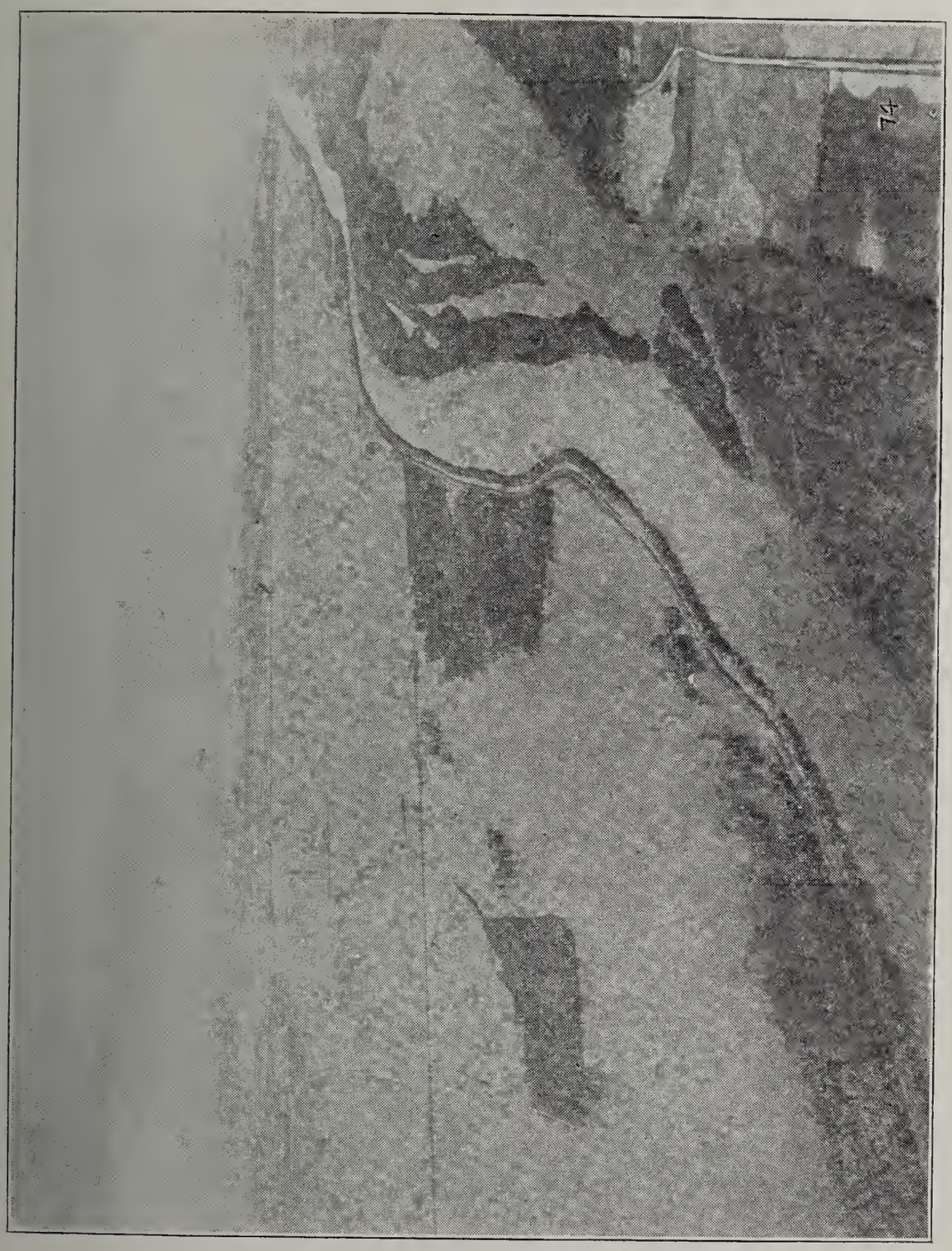
"1. The right-of-way for levee and borrow-pits should be provided free of cost to the State with written authority from the owner or owners to enter upon and construct or repair the levees.

This picture taken October 15, 1926, shows the city of Beardstown inundated and completely surrounded with water. The South Beardstown Drainage and Levee District is shown in the right foreground. The channel of the Illinois River is indicated by the highway and railroad bridges shown in the left middle distance.

The Illinois Legislature appropriated $350,000 and $46,000 contributed by the Chicago, Burlington & Quincy Railway and the Baltimore & Ohio Railway to pay the cost of constructing a concrete wall along the river bank and to provide earth levees connecting the river wall with the high ground back of the city. Beardstown has a population of 7,000. Nine-tenths of the city was under water up to a maximum of 15 feet.

2. So far as possible profile drawing and description of the work to be done, with specifications, should be prepared for each and every separate contract or piece of work.

3. Standard form of contract should be prepared of which the profile drawing, description and specifications should be a part, with optional clauses



Airplane picture showing flooded Lacey and Langellier Drainage and Levee Districts above the levee and flooded portions of West Matzanas District below the levee.

providing for lump sum settlement upon completion of the work or installment payments on monthly estimates.

4. In all cases where payment is to be made on monthly estimates, a surety company bond equal to one-half the amount of contract should be provided for."

THE FLOOD RELIEF LAW.

(Senate Bill No. 576. Approved July 7, 1927.)

An Act making an appropriation to furnish emergency relief in the areas in Illinois which have been inundated or damaged by floods and for the temporary construction, repair and reinforcement of levees in such districts.

WHEREAS: As the result of recent abnormal weather conditions, certain large areas of the State of Illinois have been inundated and damaged by flood waters, particularly in the valleys of the larger streams of this State, and

WHEREAS: Such flood waters have broken or injured levees in this State, and have endangered other levees, and

WHEREAS: The suffering and loss on account of these conditions have been widespread and have become a matter of great public concern, and

WHEREAS: The residents of the areas so afflicted are unable to reclaim for cultivation large areas of overflowed lands or to make the temporary repairs or reinforcements to levees which are necessary to prevent further loss and damage, and

WHEREAS: Any relief to be administered by the State should be equitably distributed to relieve the needs and suffering of the different communities with as little burden and expense to the taxpaying public as possible; now, therefore,

Be it enacted by the People of the State of Illinois, represented in the General Assembly:

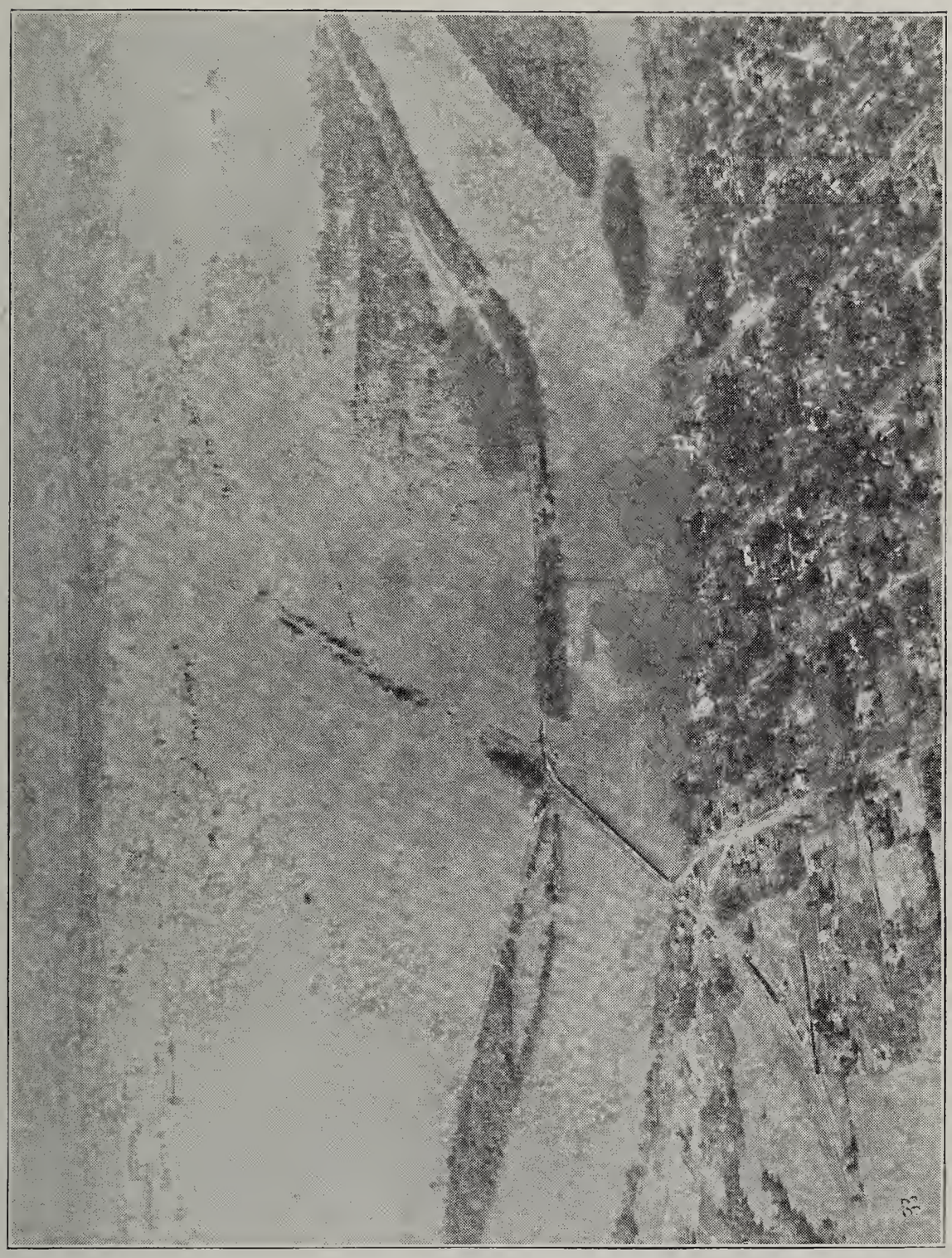
SECTION 1. There is appropriated to the Department of Purchases and Construction, for the biennium commencing July 1, 1927, the sum of one million five hundred thousand dollars ($1,500,000), or so much thereof as may be necessary, for the purpose of furnishing all necessary and proper emergency relief in areas which have been inundated and damaged by flood waters and for making temporary repairs to, or furnishing temporary reinforcements for levees which have been or which are in danger of being damaged by the flood waters of the last several months, and to reclaim or restore inundated and overflowed lands.

SEC. 2. This appropriation is subject to the provisions of "An Act in relation to State finance," approved June 10, 1919, as amended.

SEC. 3. Because of the facts recited in the preamble of this Act and the further fact that relief measures to be effective to the greatest degree, must be promptly put in operation, an emergency exists and this Act shall take effect upon its passage.

ATTORNEY GENERAL'S OPINION.

In anticipation of the enactment of the Flood Relief bill, (S. B. 576) and to avoid, so far as possible, any delay in carrying out the provisions thereof, the Attorney General was asked for an advance opinion



Meredosia, on the Illinois looking west over McGhee Creek levee and drainage district.

Where the Illinois and Mississippi Rivers overflow onto thousands of the most fertile acres in the world. The shaded portions are the areas which are habitually overflowed by the rivers when high waters come, or which were submerged during the floods of 1922, 1926 and 1927. Detailed reports show that total losses in excess of $30,000,000 were inflicted during the six-year period covered by these flood times. Thousands were driven from their homes, merchandise was ruined and hundreds of thousands of acres of farm lands were covered with water for months at a time.

After a survey of the flood conditions in Illinois in 1927, Governor Small in a special message to the Legislature, recommended the appropriation of $1,500,000 for emergency flood relief and to repair, rebuild and strengthen the damaged levees along the Illinois and Mississippi Rivers. The State Legislature passed the appropriation and work was started immediately.

as to the powers, duties and authority of the Director of the Department under the proposed law, which was rendered as follows:

June 30, 1927.

File No. 1087
Bills:
Senate Bill 576,
Flood Relief.

Hon. Leslie Small,
Director,
Department of Purchases and Construction,
Springfield, Illinois.

Dear Sir:

I am in receipt of your letter of the 28th instant, in which you enclose what you state to be a copy of Senate Bill No. 576, commonly known as the "Flood Relief Bill." You ask me to advise you as to the powers, duties and authorities of the Director of the Department of Purchases and Construction under this act, in making repairs to damaged levees and in the work of reclaiming overflow land with special reference to the following:

"(1) Would it be lawful for the Department to do any part or all of this work by the employment of hired labor, the purchase of materials and supplies and the purchase or rental of necessary equipment?

(2) Would it be lawful for the Department to make contracts with private persons or corporations (or with quasi public corporations) to provide labor, materials and equipment and to perform any part of the work required at an agreed price, or on a cost plus basis?

(3) Will it be necessary for the Department to advertise for bids on contracts or materials for levees and reclamation work under this act? If so, in what publications and for how long must such advertising appear?

Because of the emergent situation which this law is intended to relieve, this Department has caused a preliminary survey of conditions to be made in a large part of the flood areas and I am advised that, in some cases, contractors with adequate equipment, are now situated at points where emergency work is needed.

It is probable that advantageous contracts could be made in such cases, if the Department has authority to enter into same without the necessity of waiting to advertise for competitive bids. In other words, a contractor who has his equipment on the job can afford to work cheaper than one whose equipment must be brought from afar, but such contractors would have to increase their charge to cover delays if advertising and competitive bidding are held to be essential."

In answer to your questions Nos. 1 and 2, beg to advise that I can find no constitutional requirement or statutory provision directing the manner in which you may cause this work to be done as far as a method of contracting for the same is concerned.

In answer to question No. 3: The constitution and statutes are silent as to the requirements to advertise for bids on contracts, except such contracts pertaining to public printing and binding and fuel. (See section 25 of Article IV of the Constitution and sections 77 to 132, inclusive, of chapter 127 of Smith-Hurd's Illinois Revised Statutes.) Both the statute and the Constitution being silent on these matters, such procedure as to the carrying out of the provisions of said Bill 576

is left to the discretion of you as Director. Just how far your judgment can go in making repairs to damaged levees and the work of reclaiming overflowed lands is a matter not easily understood and our courts so far have said very little that gives us much light on this question.

As was said in the case of *Hagler* v. *Small,* 307 Ill. 460, at 474:

"Whether a tax or an appropriation is for a public or private purpose is a question not always easy of determination. In deciding whether such purpose is public or private, courts must be largely influenced by the course and usage of the government, the object for which taxes and appropriations have been customarily and by long course of legislation levied and made, and what objects have been considered necessary to the support and for the proper use of the government. Whatever lawfully pertains to this purpose and is sanctioned by time and the acquiescence of the people may well be said to be a public purpose and proper for the maintenance of good government. (*Loan Ass'n.* v. *Topeka,* 20 Wall. 655.) What is for the public good and what are public purposes are questions which the Legislature must in the first instance decide * * *.

The power of the State to expend public moneys for public purposes is not to be limited, alone, to the narrow lines of necessity, but the principles of wise statesmanship demand that those things which subserve the general wellbeing of society and the happiness and prosperity of the people shall meet the consideration of the legislative body of the State, though they oft-times call for the expenditure of public money. If it can be seen that the purpose sought to be obtained is a public one and contains the elements of public benefit, the question how much benefit is thereby derived by the public is one for the Legislature and not the courts."

In view of the language of the Supreme Court, it appears to me that the Legislature in stating the purposes for which said appropriation mentioned in said bill may be used in so far as such bill limits such purposes to the furnishing of all necessary and proper emergency relief by making temporary repairs or furnishing temporary re-enforcements for levees which have been, or which are in danger from being damaged by flood waters same is valid.

In repairing and in re-enforcing levees the State by the use of such funds would subserve the general well-being of society and the happiness and prosperity of the people in general. It would protect the lives of those persons who reside in the territory affected by such flood waters.

Further, the Director is empowered to use such appropriation for the purpose of necessary proper emergency relief in areas affected.

However, that part of section one which provides that such fund may be used for the purpose "to reclaim or restore inundated or overflowed lands" presents a question of more serious difficulty. In the first place, the title of the Act, which is as follows:

"An Act making an appropriation to furnish emergency relief in the areas in Illinois which have been inundated or damaged by floods and for the temporary construction, repair and reinforcement of levees in such districts."

presents the question whether or not the title of such Act is broad enough to include the power to reclaim or restore inundated lands. Giving an emergent relief could hardly be extended to include the reclamation or restoration of inundated lands. (See section 13, Article IV of the Constitution.)

In construing said clause of said section one, to-wit: "to reclaim or restore inundated and overflowed lands" it is necessary to take into con-

sideration also section 20 of Article IV of the Constitution, which provides as follows:

"The State shall never pay, assume or become responsible for the debts or liabilities of, or in any manner give, loan or extend its credit to or in aid of any public or other corporation, association or individual."

No question would arise under this provision of the Constitution as to the right of the Department of Purchases and Construction to use any part of such funds for the restoration and reclamation of lands owned by the State or some division of the State.

But as to the restoring or reclaiming of inundated lands which are owned by private parties, a more serious question arises. A search of the authorities of this State fails to disclose where such question has been passed upon by our higher courts. The lands belonging to private parties and having been inundated or overflowed by the unusual floods during the past year would be aided by the use of the expenditure by the State of money to restore such lands to the condition in which they were before the flood.

By reason of such apparent defect in the title and by reason of such part of said section 1 as appears to violate section 20 of Article IV of the Constitution, aforesaid, I am not prepared to hold that such act is not free from constitutional objection.

But the constitutional objection to the use of such funds for the purpose "to reclaim or restore inundated lands" would not apply to the other purposes enumerated in said bill and as to such other purposes enumerated in said bill I make no objection as to the form or constitutionality thereof.

Because therefore of such constitutional questions arising under said bill, it would appear to me that such contracts entered into by the Department of Purchases and Construction should not include work that has to do with the reclaiming and restoring of inundated lands.

Since these contracts are of such nature that it will be unnecessary for your department to submit them to public bids, of course it follows from what has been said herein that no publication of notice for bids on contracts or materials will be required.

Very truly yours,

(Signed) Oscar E. Carlstrom,
Attorney General.

LAKE LEVEL LITIGATION.

In cooperation with the Attorney General of Illinois and with engineers and attorneys for the Sanitary District of Chicago, the Division of Waterways aided in preparation and presentation of evidence for the defense, in the hearings before Charles Evans Hughes as Special Master for the Supreme Court of the United States in the proceedings brought by the State of Wisconsin and others against the State of Illinois and the Sanitary District of Chicago to restrain the diversion of water from Lake Michigan at Chicago through the Chicago Sanitary and Ship Canal into the Mississippi River by way of the Des-Plaines and Illinois rivers.

The subject of this litigation was deemed to be of so much importance to the Waterway interests of the State of Illinois that unlimited time was devoted to investigation of the facts involved in order that the testimony of the expert witnesses for the State might be full and complete. Mr. M. G. Barnes, Chief Engineer, and Mr. Murray Blanchard, Hydraulic Engineer for the Division, spent much time in preparation for this case and both of them were in Washington in attendance upon the hearings before Judge Hughes from November 28 to December 19, 1926; February 19 to March 6, 1927; March 19 to 28, 1927; May 29 to June 4th, 1927; in addition to the foregoing Mr. L. D. Cornish, Assistant Chief Engineer, was in Washington from February 19th to March 6, 1927.

DATA COMPILED IN CHICAGO OFFICE.

In the Chicago office the following data were compiled for testimony, and exhibits were prepared, for use in the hearings at Washington before Special Master Chas. Evans Hughes:

1. History of the Illinois & Michigan Canal having a bearing on early diversion of water from Lake Michigan.
2. History of Illinois Waterway Reports, Applications for Permits, Permits, Hearings, Litigation, Acts, Agreements, etc., showing the various efforts that have been made to obtain the diversion and construct the waterway.
3. Collection of correspondence and negotiations concerning the amount of diversion.
4. Studies of possible power development in Illinois Waterway.
5. Compilation of transportation data and studies of harbor facilities.
6. Studies of the effect of various diversions on the DesPlaines, Illinois and Mississippi rivers.
7. Studies of the effect of proposed regulating and compensating works upon water levels of Great Lakes.
8. Preparation of charts, compilation of statistics and studies concerning transportation on the Great Lakes.
9. Preparation of tables and charts, compilation of data and studies of the water supply and run off of the Great Lakes.
10. Compilation of maps, designs and data relating to the construction of the Illinois Waterway.
11. Effect of improvements on the connecting channels of the Great Lakes.

CONTROVERSIAL POINTS INVOLVED.

The main controversial points in the hearing, on which the Division Engineers testified, were:

1. Excavations made in the narrows of the St. Clair River at Port Huron had the effect of lowering Lakes Michigan and Huron some five inches.
2. Regulation or compensation are practical means to counteract the effect of lake level lowering.

3. Diversion of water from one watershed to another is not without precedent in this country.

4. Total elimination of diversion at Chicago would be impracticable and endanger the lives of millions of people.

5. A withdrawal of 10,000 second feet at Chicago has an economic value on a par with or exceeding its value in flowing to the St. Lawrence River.

6. The value of the Illinois Waterway to consumers and shippers in reduction of cost of transportation over cost by rail would exceed $1.00 per ton and amount to at least $30,000,000 per year, which is equal to a capitalized value of $750,000,000. (Barnes 5891, 5892.)

7. Evidence submitted to show that an economic disaster fairly estimated at one hundred million dollars is involved in the proposed destruction of the Illinois Waterway by eliminating diversion entirely.

"CHICAGO BUSINESS VIEWS WATERWAY."

Commerce Association Inspects Illinois' Preparations to Connect Great Lakes and Gulf.

Note: The following article, which appeared in Chicago Commerce November 6, 1926, is from the pen of Mr. Wm. Hudson Harper, Editor of that publication:

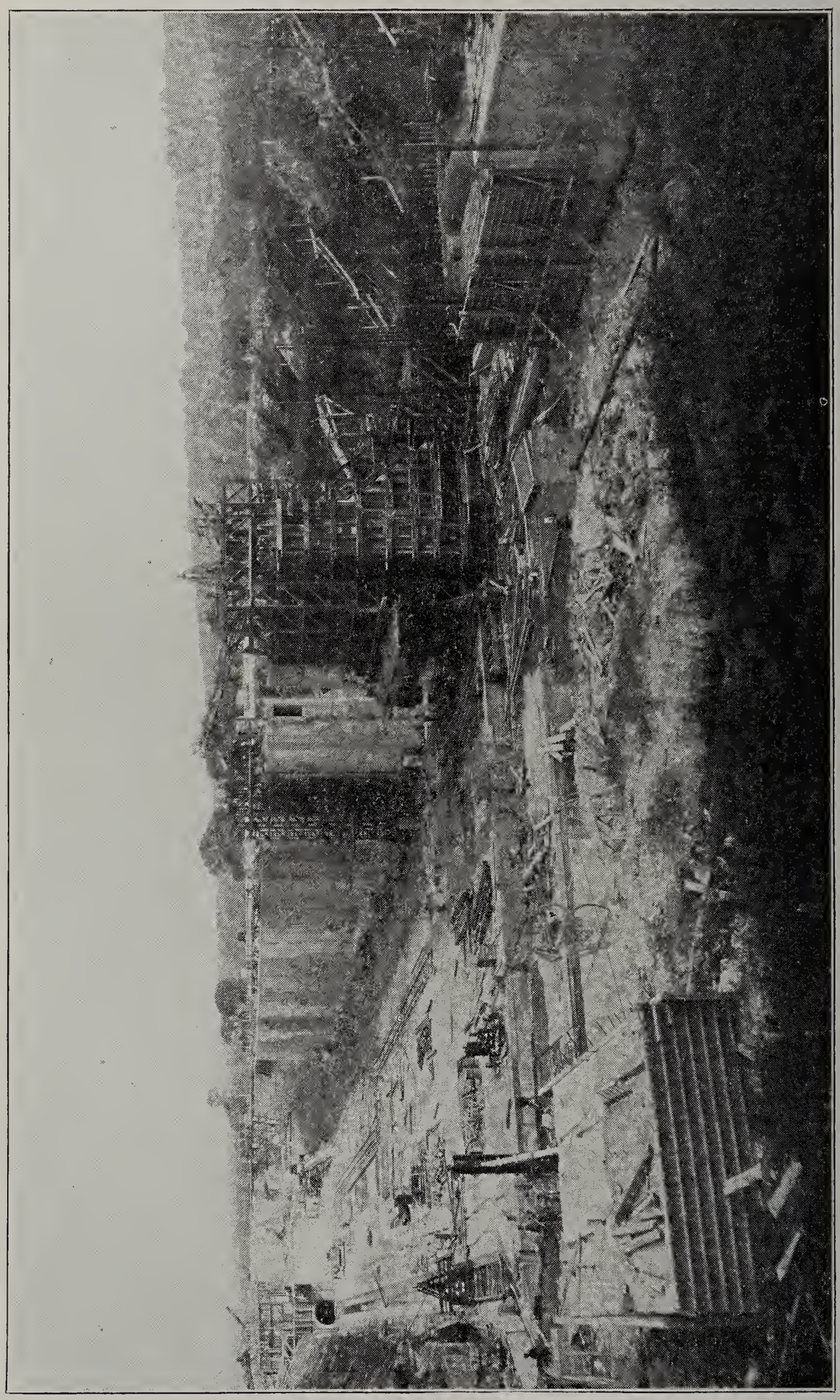
A Chicagoan perhaps takes for granted his city's drainage and navigation system. He is content that a great city no longer makes a cesspool of its fountain. He votes for bond issues and officers and the ways and means of drainage disposal and waterway improvement, but does he really know or anywhere near evaluate the Chicago terminal of the Lakes-to-the-Gulf waterway to be—soon to be, revolutionary to be?

Now, a projected water traffic route between Chicago and New Orleans, the flowing way for manufacturer and farmer from Great Lakes to sea, has no self-starting or self-finishing principle. Individual states, government of the United States, competing cities, all must see an improvement of this nature as a major, a continental undertaking, and the force to see and demonstrate the carrying of it into execution is business. Politics plays its part, but it is business that conceives and realizes, and therefore business must know.

BUSINESS LEADERS GO VOYAGING.

Thursday, October 28, President William R. Dawes and John T. Pirie, chairman of the Association's Transportation Committee, took some twenty-five representative business men, together with representatives of the press and members of the official staff of the Association of Commerce, for an all-day visit to the Illinois waterway project. The excursion was realized to the greatest advantage through the cooperation of William F. Mulvihill, superintendent of the State Division of Waterways; through the courtesy of the Sanitary District of Chicago by use of its boat, the Edora, and by virtue of various preliminary preparations conducted by J. P. Haynes, traffic director of the Association of Commerce.

It was the idea of Mr. Dawes and Mr. Pirie to aid Chicago business to discover the significance, in an industrial and transportation sense, of the great drainage channel—what is being done and has been planned to be done to make a practical waterway route in that section of Illinois between Chicago and the Mississippi River, for which Illinois is responsible, namely, between Lockport and Utica, an improvement which the citizens of the State have formally resolved to make and to the construction of which they have dedicated a bond issue of $20,000,000.



Photograph showing construction progress on Starved Rock lock. By direction of Governor Small the first bids of $2,825,040 were rejected. The present contract price is $1,475,832.

FIVE LOCKS AND DAMS IN SYSTEM.

What an expedition of business men set forth to see was the engineering and projected engineering along a waterway route extending from Lake Michigan some 95 miles down the valley of the Illinois River, the southern end of this stretch being marked by nature by the historic Starved Rock, in front of which an economic instrumentality to form the last dam and lock proposed for the Illinois improvement section of the waterway is now under construction.

Five dams and locks are embraced in the section between Lockport, near Joliet, and Starved Rock. At Lockport is the first, at Brandon Road, a few miles away, the second; at Dresden Island, more than fifty miles from Chicago and fifteen miles from Joliet, is the third. At Marseilles is already finished the fourth lock and dam, and this construction is eighty miles from Chicago, and at Starved Rock a mighty excavation foreshadows the future site of the fifth and last lock and dam. Two of the five great units may be said to be complete, and perhaps three years will see all units finished.

The expedition saw all that could be seen in a long day, twilight enveloping its members as they gazed almost with wonder at the partly water filled hole which is to be the scene of the lock and dam at Starved Rock.

WHO WENT TO SEE THE BIG THING.

Men who accepted President Dawes' invitation to make this interesting excursion—not a junket but a university course on waterway economics—were the following, Mr. Mulvihill being general guide, philosopher and friend:

B. F. Affleck, president of the Universal Portland Cement Company, a corporation concerned in big tonnage; V. L. Alward, president of the American Furniture Mart, whose monumental institution centers the furniture trade in Chicago; M. G. Barnes, chief engineer of the Waterways Division of Illinois and one of the creative spirits of the Panama Canal; Frederick T. Boles, a waterway shipper of years and a leader in promotion of waterways; Joseph K. Brittain, president of the Chicago Real Estate Board and chairman of the Association's Committee on Industrial Development and Public Improvements; J. S. Brown, representing the Board of Trade; Roy W. Campbell, president of the Chicago Shippers Conference Association; Sheldon Clark, hardy lake man and also vice-president of the Sinclair Refining Company, an important industrialist; L. D. Cornish, assistant chief engineer of the State Division of Waterways; John V. Farwell, one of Chicago's foremost merchants and citizens; H. C. Gardner, engineer, chairman of the Great Lakes-St. Lawrence Tidewater Association and chairman of the Association's Committee on Harbors and Waterways; John M. Glenn, veteran secretary of the Illinois Manufacturers Association, and an all-State personality; E. T. Harris, president of the Payson Manufacturing Company; Dr. Robert H. Harvey, president of D. B. Fisk & Company; Lachlan Macleay, secretary of the Illinois River Division of the Mississippi Valley Association; James E. MacMurray, chairman of the board of the Acme Steel Company.

And there were Martin B. Madden, twenty-two years a congressman from Chicago and a good one, and chairman of the Appropriations Committee of the House; R. C. McManus, Swift & Company; John T. Pirie, Carson Pirie Scott & Company; Maj. Rufus W. Putnam, late United States resident engineer and now engaged by the Commercial Club of Chicago to conduct a harbor survey and submit a harbor plan; Robert Isham Randolph, Randolph-Perkins Company, engineer, son of Isham Randolph, distinguished for service in connection with the Drainage Canal and the Panama Canal; Alexander H. Revell, Jr., president of his father's historic house; Col. Edward H. Schulz, resident district engineer, U. S. A., and successor to Maj. Putnam; Eugene S. Taylor, manager, Chicago Plan Commission; H. B. Utley, vice-president of the International Harvester Company and representing great potential shippers by water; Ezra J. Warner, president of Sprague, Warner & Company; M. B. Wheeler, representing the president of the sanitary district; four representatives of the press, including Chicago Commerce; Henry Seavey, representing Underwood & Underwood, photographers, and the fol-

lowing members of the Association's official staff; J. P. Haynes, traffic director; L. A. Dumond, manager, Industrial Department; C. W. Judd, assistant business manager; Col. H. F. Miller, manager, Domestic and Foreign Commerce committee; Thomas Wolfe, secretary, committee on Harbors and Waterways.

The party was joined at Lockport by A. T. Griffith, chairman of the Waterways committee of the Peoria Association of Commerce; W. E. Hull, Congressman, Peoria, and representatives of the Peoria Journal and Star.

INDUSTRIAL PLANTS AND SITES.

The LaSalles, Marquettes and Joliets of this latter day embarked on the Edora at the Goodrich dock at 8:30 a. m. and proceeded down the river and canal to Lockport. Passing the Wacker Drive, observers noted facilities provided on its first level for the handling of river traffic. In the continuing voyage of discovery, as the boat passed down the river and entered the great canal, big plants were noted here and there along the river banks and also many sections of frontage in disrepair and neglect. Power houses told their dynamic story as did the transforming works of the sanitary district power installation at Lockport, the current being conducted several miles up the river. Bridges of various types loomed high. It was a river vitally connected with the city's welfare but not under the intensive development, industrially speaking, commensurate with its opportunities.

Chicago knew more about the drainage canal at the years of its birth than it knows today. A very impressive accomplishment it is. Its economic potentialities are enormous. The length of the main and power channel is 29 miles; the length of the river, from the lake to Robey Street, 6 miles, and the length of the river diversion channel 13 miles. The great cut has at the north an earth section and at the south a rock section. The canal's present capacity is 600,000 cubic feet per minute. The nominal minimum depth of water in the main channel is 22 feet, and the width of the main channel varies at the top from 198 to 225 feet. Construction costs of the great work up to December 31, 1923, were $94,371,038. In 1924 the equalized value of the property of the sanitary district was declared to be $1,917,628,603 and the total bonded debt $37,895,000.

WHEN BEGUN AND FINISHED.

Work on the drainage and ship canal was begun September 3, 1892, and on January 5, 1900, water was turned in. The main channel extension was completed on August 27, 1907, and on November 26 of that year the first electric current was delivered to Chicago from the Lockport power house. Construction of tributary improvements followed in other years.

The sanitary district has an era of 437.39 square miles, including all of Chicago and forty-nine other incorporated cities and villages.

As the observation tour progressed, particularly through the extensive rock cut section, the magnitude and dignity of the engineering work became more apparent, and questions were generally asked about the vast accumulations of rock, course and fine, constituting, on either side of the canal, the spoil banks. These no inconsiderable hills of stone, bordering the canal for many miles, had trees growing out of their barren bosoms. For certain construction these little mountains are being resorted to by contractors, stone being deposited in barges and brought to the lake front for such use as the building of breakwaters. It seems to be a fact that this residue is not particularly available in every sort of construction work, it being cheaper for some of the requirements of breakwater building to quarry the necessary stone.

A barge of stone passed the voyagers, and also a barge of oil. The nature of these shipments prophetically spoke. When the waterway is open, and the Mississippi states and Great Lakes states are in waterway contact, these stone mountains may in one way or another become actual instead of potential assets. For the time one can think of them as waiting wealth, and the mass can be thus inventoried.

STONE ISLAND IN THE LAKE.

Col. Randolph was asked what all these miles of stone would amount to if their equivalent were reared in some imaginary cube in the heart of the loop or deposited off the lake front. The colonel figured for a few minutes, and he made this answer:

"The grand total of glacier drift and solid rock was 42,229,035 cubic yards. The rock when broken up expands about 80 per cent, and therefore the volume of the rock spoil banks was nearly 22,542,580 cubic yards. If we were to remove the whole volume of spoil, that is, both earth and rock, and deposit it in Lake Michigan in 40 feet of water, we would have an island one mile square with its surface twelve feet above water."

The observation party viewed at Lockport the new locks and existing power house, the former a structure of magnificient proportions and of a size unexpected even in a commonwealth of big things. The exploring party stood upon one of the walls of the monster lock, and Mr. Mulvihill explained that under the waterway act of 1919 the DesPlaines and Illinois rivers are being canalized to connect the Chicago drainage canal at Lockport with the navigable waters of the Illinois River near Utica, a distance of sixty-five miles. In the section of the Illinois waterway now under development, the whole totaling 1,600 miles from New Orleans to Chicago, there are to be five locks having a total lift of 126 feet—at Lockport 41 feet, at Brandon road 31 feet, at Dresden Island 17 feet, at Marseilles 21 feet, at Starved Rock 16 feet. Under the pending Illinois improvement bill there will be two more locks in the section between Utica and Grafton.

GIGANTIC LOCKS IMPRESS VISITORS.

Scanning the huge and empty lock at Lockport, the explorers, guided by Mr. Mulvihill, realized how big a utility is a structure which is 600 feet long with a lift of 41 feet and a width of 110 feet. They looked upon engineering already 95 per cent finished, and later they passed two sites for dams and locks not yet under contract. They saw at a distance the general location of the Marseilles lock and dam, and when "the shades of night were falling fast" they stood beside the huge excavation at Starved Rock, which the adjoining Illinois River has filled with water to the extent, at one end, of twenty-five feet. This huge volume of water must be pumped back into the river, a setback by storm and flood to the engineers which will be as great as two months. The navigable river channel in this same section under State improvement will be not less than 150 feet at the bottom, with a depth of not less than 8 feet, which will be increased to 9 feet without extra cost, if the present annual average diversion of water from Lake Michigan of 8,500 cubic feet per second is continued.

The Chicago navigators were taken from Lockport in cars by members of the Joliet chamber of commerce and were lunched by them in their interesting new building. The guests were warmly received by prominent Joliet business men, and after a delightful luncheon there were short talks by the chairman, who was State Senator Barr, and Mr. Mulvihill, Congressman Hull, Congressman Madden and President Dawes.

TALKS AT JOLIET LUNCHEON.

Mr. Madden, a reliable friend of the great central west project, suggested that rather than a sectional undertaking this was a national undertaking in significance and consequence.

Mr. Hull, who had been lately visiting the far northwest as well as the southwest, had found an intelligent and sympathetic interest in Illinois' great project. He urged Chicago to understand the magnitude and importance of the waterway idea and its undertaking. He had found inspiration in the enterprise of Houston, Texas, which built on its own a fifty-mile waterway from the sea to make of that cotton port an interior Galveston, where already in the artificial port and canal Mr. Hull had counted seventeen sea-going ships.

Mr. Dawes assured the Joliet representatives and all others concerned in the common cause that Chicago appreciated the value of what it was after;

that it was after it to get it, and that it solicited the support of every interest involved.

JOLIET'S LEADERS AT CONFERENCE.

The Joliet hosts of the Chicago party were Senator R. J. Barr, chairman of Joliet chamber of commerce waterway committee, presiding at luncheon; Theo. R. Gerlach, president Joliet chamber of commerce, president of the Gerlach-Barklow Company; J. R. Blackhall, past president of chamber, also operating vice-president of Chicago & Joliet Electric Railway Company; A. H. White, district manager of Illinois Bell Telephone Company, and a director of the chamber; Wm. Richards, director; L. C. Stephens, district manager of Public Service Company of Northern Illinois, and chairman of intercity committee; Geo. Buck, Werden-Buck and Company; Walter Jones, Farrell Manufacturing Company; Wm. Kemp, Edw. Morton, Col. Fred Bennitt, waterway committee; Irving A. Berndt, managing director of chamber.

The touring party moved by a special car of the Illinois Traction system from Joliet to Belle Isle, forty-one miles, to get an impression of the surroundings of the Marseilles lock, and then the party continued on to Starved Rock, arriving in time in the deepening twilight to see the beginnings of lock construction on a Panama canal scale. The party returned to Ottawa to take a special Pullman car and diner of the Rock Island lines and reached Chicago about 9:30 o'clock.

Among the best informed of Illinois' waterway champions is the Superintendent of Waterways, William F. Mulvihill, who during the day of the tour made several little talks in answer to questions. In such talks was information such as this:

SUPERINTENDENT MULVIHILL EXPLAINS WORK.

"Secretary Hoover is educating the public about our inland waterways. He is leading the Nation to think about the Mississippi system of 9,000 miles, one-third being trunk lines and two-thirds laterals. There is a main north and south line between New Orleans and Chicago and an east and west trunk line of 1,500 miles from Pittsburgh through Cairo to Kansas City. The north and south line is 1,600 miles long, and the locks of the Illinois section are built 110 feet wide, with 600 feet of usable length, and can handle 9,000 tons of freight at one lockage.

"To more easily visualize the magnitude of tonnage capacity of these locks, the picture can be expressed in box car loadings. Using the average railroad car loading for the country, the capacity of each of these locks at one locking is found equivalent to a freight train 2.84 miles long, or nearly three miles long.

PREPARING FOR EQUIPMENT INTERCHANGE.

"The locks are uniform in size with those being built by the government in the Ohio River, and so the trunk lines can interchange standardized equipment; and so the importance appears of the government improving the lower Illinois and Mississippi rivers so as to make a uniform 9-foot channel in the lower Mississippi.

"The work of the federal barge line between St. Louis and New Orleans shows that with open river navigation and a dependable channel of 9 feet, the cost of haul between Chicago and the Gulf would be greatly reduced. Let us not forget that the Panama canal brought about the reduction of a coast to coast haul of from $300 to $1,000 per carload. When the Illinois waterway and the Mississippi system are one, barge freight can move, by all-water routes between inland industrial centers and seaboard ports without breaking bulk.

"Railroad ton-miles are said to double every ten years. Rail congestion invites waterways and highways. A dollar will move a ton of freight four miles by horse and wagon, twenty miles by truck, 100 miles by railroad, but 750 miles on the Illinois and Mississippi waterway and 1,000 on the freight boats of the Great Lakes.

"The Illinois River drains about 40 per cent of the land area of the State, fertile land producing more than 200,000,000 bushels of grain, of which 60 per cent is exported. Truck transportation by good roads would place this surplus on barges for Chicago or New Orleans and be moved at materially less than at rail rates.

"Chicago consumes 36,000,000 tons of coal every year, and at least 15,000,000 tons would move by river and canal from southern Illinois and Kentucky at a saving of over $11,000,000 per year, or at least 75 cents a ton.

"So much for the farmers. The manufacturers and other shippers of Chicago, and all classes of shippers from Lake Michigan ports are interested in a cheap route south to southern and western states and beyond. Domestic markets are interested in South America, Pacific Coast and Asia. Such a transportation route would also reduce the cost of haul on foreign shipments imported through New Orleans, as well as on domestic products of southern origin required in the north. The north wants sugar, coffee, rice, sulphur, sisal, etc.—millions of tons.

"Chicago business men have seen today what has been accomplished, and we advise them of plans for locks and dams not yet provided for, namely, at Brandon road and Dresden Island, and for which contracts will be let as soon as titles and needed right-of-way can be secured and bids offered. We estimate that it will take three years from the time the last contract is let before the system is complete."

ILLINOIS AND MICHIGAN CANAL LAW AMENDMENT.

Lease of Illinois-Michigan Canal.

At the election held November 2, 1926, a vote was taken on the question of adopting an Act of the Illinois General Assembly authorizing the lease by the Department of Purchases and Construction of certain lands constituting a part of the Illinois and Michigan Canal and its right-of-way between Joliet and connection with the Chicago River. The vote was yes, 808,718; no, 417,039. The proposal was not carried because of the constitutional requirement that a majority of all persons voting at the election must vote in the affirmative for the proposed amendment.

The Illinois Waterway Act makes no provisions for terminals to meet the needs of anticipated water transportation development.

The I. & M. canal lands proposed to be leased, comprising the bed of the old canal and a 90-foot strip on each side thereof and extending from Ashland Avenue in Chicago to Lockport, are no longer needed for canal purposes, but could be made to serve the needs of navigation by capitalizing the rent received under any leases made and applying such capital to the construction or development of public terminal facilities for water-borne commerce.

The rights of the people of the State were carefully safeguarded by the express terms of the Act they were asked to ratify by their ballots, which in part provides as follows:

Section 1. The Department of Purchases and Construction of the State of Illinois be and said department is hereby authorized by and with the consent and approval of the Governor of the State to lease and utilize all or any portion of said Illinois and Michigan Canal and its right of way which, in the opinion of the Director of the department, is no longer required for the purpose of navigation or public water terminals between the city of Joliet in the county of Will and the Chicago River in the county of Cook, in the State of Illinois, upon the following specific terms and conditions:

1. Preference shall be given to leasing for the development of water terminal facilities and the interchange of freight between rail and water or water and rail for public use.

2. Leases shall not be made for a period exceeding ninety-nine (99) years and all leases made shall be subject to a revaluation of the property every ten (10) years.

3. The rental to be received by the State shall be a net return of not less than six (6) per cent per annum upon the valuation of said Illinois and Michigan Canal and its right of way, or any portion thereof, that may be leased, the lessee to pay any taxes, if any, lawfully assessed against such property.

ENGINEERING REPORT.

By M. G. Barnes, *Chief Engineer.*

THE ILLINOIS WATERWAY.

The fiscal year ending June 30, 1927 was not a very favorable year for construction on "The Illinois Waterway." Heavy rains occurred in the fall of 1926, beginning the latter part of August. During the winter and early spring of 1927, additional heavy rains again resulted in flood conditions along the Illinois River. At times the water was so high in the river adjacent to Starved Rock lock and dam that the contractor for this job was prevented from doing any construction work, and in fact, the Chicago, Ottawa & Peoria Railroad, which serves this project, was under water and unable to function. The highways leading to the site of this construction were also inundated and impassable. These conditions made it impracticable for the contractor to make the progress in construction called for by the contract.

Before the end of the fiscal year these high waters had subsided and the contractor, Woods Brothers Construction Company, was able to resume active operations. Preparations were made for night and day work, which will be prosecuted actively until the contractor has made up for lost time occasioned by the floods. Although the work at Starved Rock has been somewhat delayed by the unfavorable weather conditions, it is probable the State will not suffer any serious inconvenience therefrom. At the end of the fiscal year the work was about 35 per cent completed, whereas the prescribed rate of progress called for 75 per cent completion.

The construction work at Lockport is outside of the river channel and not influenced by flood conditions. Contractors on that project made much better progress than could have been made had the work been affected by floods. At the end of the fiscal year, the work of building the lock walls under contract with Green & Sons Company was 98 per cent complete, whereas the prescribed rate called for 100 per cent completion.

LOCK GATES CONTRACT AWARDED.

During the fiscal year the contract for the lock gates for Lockport and Marseilles has been let to the Independent Bridge Company of Pittsburgh, Pennsylvania, and the fabrication of the steel is progressing satisfactorily. This work should be entirely completed during the next

ILLINOIS WATERWAY.

CONTRACT NO. 6—CANVASS OF BIDS RECEIVED OCTOBER 26, 1926.

Item number.	Item.	Unit.	Quantities.	Thos. LeRoy Warner, 111 N. Dearborn St., Chicago, Ill.		H. E. Culbertson Co., 1577 Union Trust Bldg., Cleveland, Ohio.		Henry W. Horst Co., Rock Island, Ill.		M. E. White & Co., 1735 Fullerton Ave., Chicago, Ill.		T. J. Forsehner Construction Co., 3153 Bryn Mawr Ave., Chicago, Ill.		Great Lakes Dredge & Dock Co., 104 S. Michigan Ave., Chicago, Ill.		Average of all bids received.	
				Price.	Amount.	Price.	Amount.	Price.	Amount.	Price.	Amount.	Price.	Amount.	Price.	Amount.	Price.	Amount.
A	Clearing	Lump sum	1	$ 3,000 00	$ 3,000 00	$ 21,500 00	$ 21,300 00	$ 11,000 00	$ 11,000 00	$ 23,000 00	$ 23,000 00	$ 10,000 00	$ 10,000 00	$ 3,450 00	$ 3,450 00	$ 11,958 333	$ 11,958 333
B	Cofferdams, pumping, etc	Lump sum	1	40,000 00	40,000 00	120,000 00	120,000 00	190,000 00	190,000 00	161,000 00	161,000 00	125,000 00	125,000 00	90,577 00	90,577 00	121,096 167	121,096 167
C	Excavation	Cu. yd	202,000	1 50	303,000 00	2 40	484,800 00	2 35	474,700 00	2 40	484,800 00	3 00	606,000 00	3 88	783,760 00	2 588	522,843 333
D*	Channeling	Sq. ft	10,000	1 50	15,000 00	1 50	15,000 00	1 35	13,500 00	95	9,500 00	1 00	10,000 00	95	9,500 00	1 208	12,083 333
E	Pine and fir timber	1,000 ft. B. M	15	100 00	1,500 00	100 00	1,500 00	104 00	1,560 00	125 00	1,875 00	200 00	3,000 00	129 00	1,935 00	126 333	1,895 00
F	Structural Steel	Pound	16,000	10	1,600 00	10	1,600 00	12	1,920 00	10	1,600 00	14	2,240 00	14	2,240 00	117	1,866 667
G	Gray iron castings	Pound	20,000	10	2,000 00	10	2,000 00	15	3,000 00	10	2,000 00	16	3,200 00	15	3,000 00	127	2,533 333
H	Cast iron pipe and specials	Pound	2,060,000	5½	113,300 00	05	103,000 00	06½	133,900 00	08½	175,100 00	09	185,400 00	06	123,600 00	067	139,050 00
I	Concrete	Cu. yd	160,000	8 50	1,360,000 00	6 85	1,096,000 00	6 75	1,080,000 00	8 15	1,304,000 00	9 00	1,440,000 00	9 80	1,568,000 00	8 175	1,308,000 00
J	Metal reinforcement	Pound	11,500	10	1,150 00	08	920 00	07	805 00	07	805 00	08	920 00	08	920 00	080	920 00
K	36″ Vitrified pipe and specials	Linear foot	130	8 00	1,040 00	15 00	1,950 00	11 00	1,430 00	10 00	1,300 00	15 00	1,950 00	16 70	2,171 00	12 617	1,640 167
L	30″ vitrified pipe and specials	Linear foot	700	6 00	4,200 00	12 00	8,400 00	8 00	5,600 00	7 50	5,250 00	10 00	7,000 00	13 20	9,240 00	9 450	6,615 00
M	24″ vitrified pipe and specials	Linear foot	40	5 00	200 00	10 00	400 00	7 00	280 00	4 50	180 00	6 00	240 00	6 25	250 00	6 458	258 333
N	20″ vitrified pipe and specials	Linear foot	180	3 00	540 00	7 00	1,260 00	5 00	900 00	3 50	630 00	4 50	810 00	4 20	756 00	4 533	816 00
O	18″ vitrified pipe and specials	Linear foot	150	2 00	300 00	5 00	750 00	4 50	675 00	3 00	450 00	4 00	600 00	3 50	525 00	3 667	550 00
P	15″ vitrified pipe and specials	Linear foot	80	1 50	120 00	4 00	320 00	4 00	320 00	2 00	160 00	3 00	240 00	2 00	160 00	2 750	220 00
Q	12″ vitrified pipe and specials	Linear foot	1,000	90	900 00	3 00	3,000 00	2 50	2,500 00	1 50	1,500 00	2 00	2,000 00	1 50	1,500 00	1 900	1,900 00
R	8″ vitrified pipe and specials	Linear foot	100	70	70 00	2 00	200 00	2 00	200 00	1 00	100 00	1 25	125 00	85	85 00	1 300	130 00
S	6′ vitrified pipe and specials	Linear foot	2,800	50	1,400 00	1 00	2,800 00	1 25	3,500 00	75	2,100 00	1 00	2,800 00	56	1,568 00	843	2,361 333
T	Pipe railing	Pound	400	25	100 00	50	200 00	75	300 00	60	240 00	40	160 00	30	120 00	467	186 667
U	Excavation in public utilities tunnel and shaft	Cu. yd	2,250	9 00	20,250 00	25 00	56,250 00	19 00	42,750 00	25 00	56,250 00	25 00	56,250 00	8 36	18,810 00	18 560	41,760 00
V	Concrete in public utilities tunnel and shaft	Cu. yd	700	20 00	14,000 00	25 00	17,500 00	30 00	21,000 00	22 50	15,750 00	30 00	21,000 00	10 50	7,350 00	23 000	16,100 00
W	Dry stone packing in public utilities tunnel and shaft	Cu. yd	150	5 00	750 00	10 00	1,500 00	8 00	1,200 00	6 00	900 00	8 00	1,200 00	5 56	834 00	7 093	1,064 00
X	Ventilating blower and motor in public utilities tunnel	Each	1	500 00	500 00	1,000 00	1,000 00	1,100 00	1,100 00	500 00	500 00	1,500 00	1,500 00	500 00	500 00	850 00	850 00
Y	Pump motor and extension shaft in public utilities tunnel	Each	1	500 00	500 00	1,500 00	1,500 00	1,900 00	1,900 00	1,800 00	1,800 00	1,500 00	1,500 00	2,200 00	2,200 00	1,566 667	1,566 667
Z	14″ iron body bronze mounted gate valve in public utilities tunnel	Each	4	500 00	2,000 00	150 00	600 00	180 00	720 00	200 00	800 00	250 00	1,000 00	195 00	780 00	245 833	983 333
AA*	Restoring pavement	Sq. yd	1,000	4 00	4,000 00	5 00	5,000 00	4 00	4,000 00	4 00	4,000 00	4 00	4,000 00	4 20	4,200 00	4 20	4,200 00
BB	Setting metal work furnished by State	Pound	25,000	03	750 00	05	1,250 00	04	1,000 00	04	1,000 00	10	2,500 00	03½	875 00	049	1,208 333
	Total				$1,892,170 00		$1,950,000 00		$1,999,760 00		$2,256,590 00		$2,490,635 00		$2,638,906 00		$2,204,676 83

* See proposal.

fiscal year. This will make it possible to contract for the excavation in the Marseilles canal without endangering the work at Marseilles lock.

The contract covering the construction of the retaining walls through the city of Joliet was again advertised and bids received on October 27, 1926. Canvass of bids on this contract is submitted herewith. All bids were rejected, and the contract has not been again advertised.

ILLINOIS AND MICHIGAN CANAL.

The almost unprecedented rainfall and high water conditions along the canal below Ottawa caused a break in the canal banks which did considerable damage to the canal, but fortunately private property suffered comparatively little damage. This break caused the closing of the canal for the balance of the season while repairs were being made.

Again in June, 1927, a very heavy downpour occurred just below Joliet. This so raised the water in the adjacent creeks and the canal that the south bank of the canal was overtopped and washed out. This break in the canal was repaired by the State's forces, but the canal was out of service for several weeks while repairs were being made.

During this fiscal year a new bridge was constructed over the canal at Columbus Street, Ottawa, under an appropriation made by the Legislature of 1925.

The unusually high water conditions experienced during this fiscal year has shown the necessity of rebuilding and enlarging some of the old culverts along the canal. During this year the Matchtown culvert near Marseilles was removed and replaced by a culvert of larger capacity.

SAND BLASTING AND SPRAY PAINTING OUTFIT.

The sewage laden water passing down the canal is very damaging to all paint used on canal structures. This requires constant attention and frequent repainting of canal structures. In order to accomplish this work in an efficient and economical manner, it has been found necessary to purchase a sand blasting and spray painting outfit to properly remove old paint and resurface the structures. This procedure has been followed during the fiscal year with good success. It will be necessary, however, to diligently follow this method of repair and repainting the surfaces. Tests are being continued of various brands of commercial paints to ascertain, if possible, what brands will best withstand the action of this water. These tests are being made mainly in an effort to find a paint that can safely be adopted for use on the Illinois Waterway structures.

The operation of the canal is given in more detail by Mr. John A. Walter, Auditor and Collector.

MC HENRY LOCK AND DAM.

Pursuant to an act of the General Assembly, approved June 21, 1923, the State acquired the old lock and dam located in the Fox River about two miles below the village of McHenry. This structure was

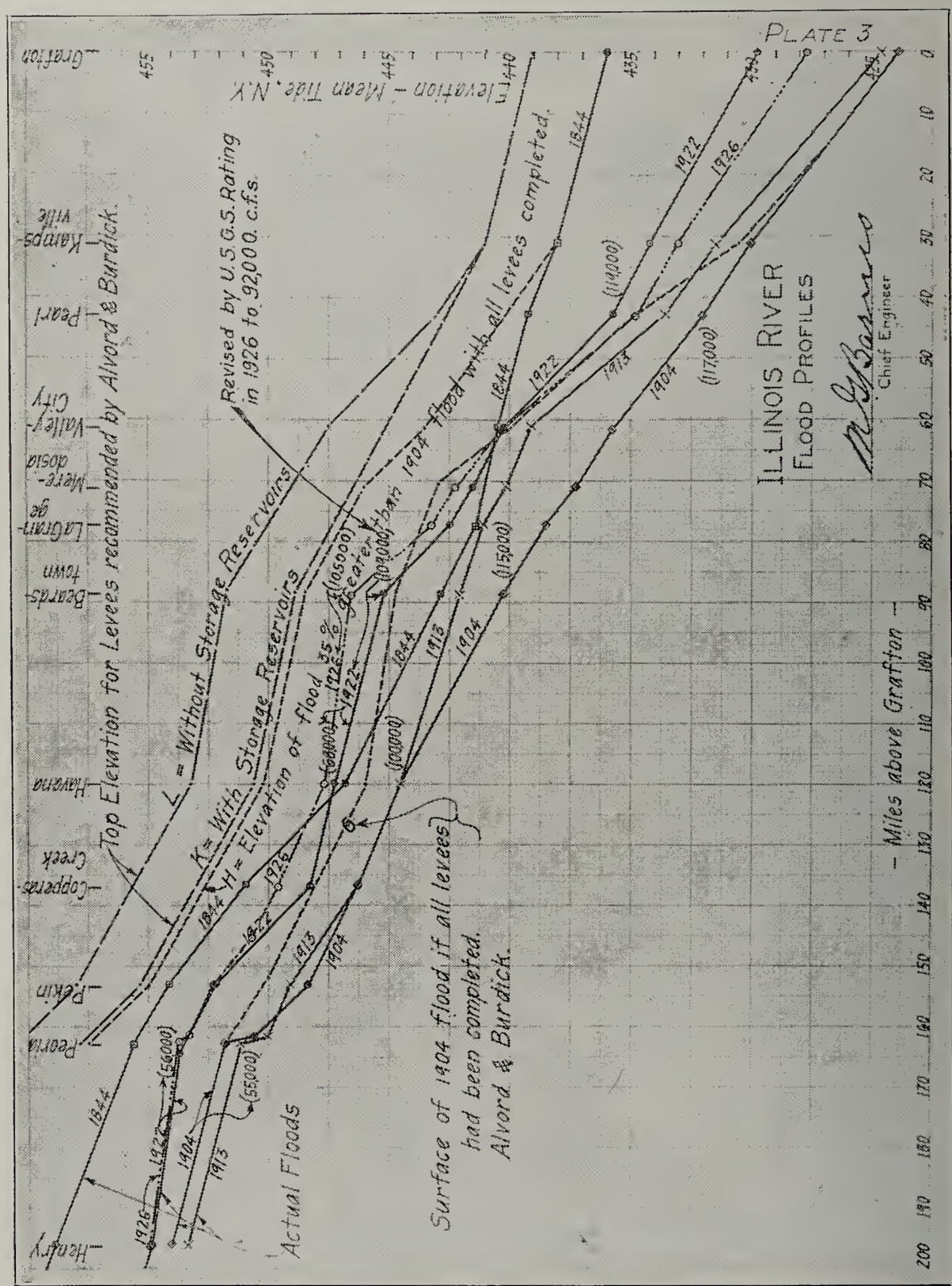


PLATE 3
ILLINOIS RIVER
FLOOD PROFILES
Chief Engineer
Elevation - Mean Tide, N.Y.
Miles above Grafton
Top Elevation for Levees recommended by Alvord & Burdick.
Revised by U.S.G.S. Rating in 1926 to 92,000 c.f.s.
L = Without Storage Reservoirs
K = With Storage Reservoirs
H = Elevation of flood 35% greater than 1904 flood with all levees completed.
Surface of 1904 flood if all levees had been completed. Alvord & Burdick.
Actual Floods
Grafton
Kampsville
Pearl
Valley City
Meredosia
LaGrange
Beardstown
Havana
Copperas Creek
Pekin
Peoria
Henry

built by private funds. The action of high water and elements had seriously damaged the dam and portions of the lock. These damages were so extensive that we were unable to maintain the pool level above the dam. The Legislature of 1927 made an appropriation of $10,000 for the repair of these structures and for operation. The contracts were prepared for rebuilding or repairing damaged portions. The contract for that work will be let within thirty days and should be completed before the low water period of 1928. With the completion of these repairs it will be possible to safely maintain the water level approximately one foot above the level previously maintained.

FLOODS.

As indicated above, the Illinois Valley was visited during the past fiscal year with two excessively high flood periods—one in the fall of 1926, and another in the spring of 1927. The flood occurring in the spring of 1927 attained approximately the same elevation in the lower reaches of the river as attained by the flood of 1922, whereas, the flood in the fall of 1926 reached even higher stages than did either the flood of 1922 or the flood of 1927, and this flood occurred while the water in the Mississippi River at Grafton was not excessively high. These floods have caused great damage to property lying along the Illinois and Mississippi rivers. The flood of 1927 occurred at the time of the great flood along the lower Mississippi which devastated vast areas of the lower Mississippi valley and seriously threatened the safety of Cairo, which, in part, lies much below the crest of the flood and the top of the levees protecting the city.

PROFILE OF FLOOD ELEVATIONS.

Accompanying this report is a profile of the flood elevations along the Illinois River as published in the department's report on the flood of 1922, and revised to include the flood of 1926. Your attention is invited to the elevation of the flood waters in the Mississippi River at Grafton at the time these floods occurred along the Illinois. Any treatment the Federal Government or the State of Illinois shall undertake to relieve flood waters along the Illinois River should take into account the importance of lowering the water in the Mississippi River at Grafton.

MISSISSIPPI HIGH-WATER AFFECTS ILLINOIS' STAGES.

The influence of the stage of the water in the Mississippi at high water periods is frequently felt from one hundred to one hundred fifty miles upstream in the Illinois River. The slope or fall in the last one hundred fifty miles of the Illinois River above Grafton at low water periods is only approximately 27 feet. From this it will be readily seen how flood stages in the Mississippi influence flood stages in the Illinois, and how important it is to prevent high water stages in the Mississippi in order to secure proper improvement of flood conditions along the Illinois River.

HIGHER FLOODS PREDICTED IN 1922.

In our flood report of 1922 it was indicated that much higher flood stages would be experienced in the Illinois River valley. The accuracy of the statements made in that report have been borne out by the record of 1926, at which time the flood stage at Beardstown was about 18 inches higher than the flood stage of 1922. The flood of 1926 occurred at a relatively low water period in the Mississippi River.

This office has twice published reports predicting high water stages in the Illinois River. The first report was made for the Rivers and Lakes Commission by Alvord and Burdick in 1914. The second report was published by the Department of Public Works and Buildings, Division of Waterways, following the flood of 1922. These reports and the charts accompanying them should be studied by the people interested and affected. Experience with these floods since the dates of the reports above referred to, justify the predictions made in those reports, and unless some flood prevention methods are put into effect, still higher flood stages can safely be predicted.

CONCLUSIONS FROM 1922 FLOOD REPORT.

It seems that the public interest is sufficient to reprint the following conclusions reached in the flood report of 1922:

1. The 1922 flood must be expected to recur probably once in ten years.
2. Greater floods must be expected at longer intervals.
3. Water in the Mississippi River at Grafton was relatively low and had the water at that point been as high as at the time of the 1844 flood, the water at Beardstown would have been materially higher and greater damage would have been done to levee districts along the lower Illinois River.
4. The quantity of water discharged at the peak of the 1922 flood was no greater than during the 1904 flood.
5. The increased stage elevations of the 1922 flood over previous floods were due to (a) the construction of levees along the Illinois River which restricted the discharge capacity of the stream and eliminated natural reservoirs, (b) reclamation and drainage of tributary streams permitting greater quantities of water to reach the river in a given period of time, (c) straightening and draining of the Kankakee River at Indiana, (d) addition of approximately 8,000 cubic feet per second of water from another water shed, the Great Lakes, (e) silt brought to the Illinois River valley from tributary streams due to higher velocities created by river improvement.
6. Greater flood elevations must be expected in the future as additional lands are reclaimed and greater restriction is placed on the discharge capacity of the stream.
7. The failure of levee districts at or near the peak of the flood prevented greater damage to other property.
8. The straightening and deepening of tributary streams increases the velocity of water, especially at flood times and causes excessive erosion of banks and beds, which material is carried to lower reaches of the streams and forms thick deposits over the flood plains. This is especially noted in the lower reaches of the Sangamon River and this condition will be aggravated as reclamation of land upstream progresses.
9. Flood heights can be lessened by (a) moving levees back further from the river banks, (b) removing islands from the channel of the stream, (c) clearing islands and shore lines of timber and underbrush, (d) using some of the present levee districts and constructing others for use as reservoirs to be filled when floods reach the danger line, (e) construction of reservoirs on tributary streams.

ANNUAL REPORT OF WALTER M. SMITH, CHIEF DESIGNING ENGINEER, JULY 1, 1926 TO JUNE 30, 1927.

The Designing Department during the year has consisted of:
One Chief Designing Engineer.
Five Assistant Engineers.
Two Draftsmen.

THE ILLINOIS WATERWAY.

LOCKPORT LOCK, CONTRACT NO. 4.

The concrete work was finished except for a small portion of the floor of the lower miter gates, which was left out to facilitate pumping during erection of gates. The steel work included in Contract 4 was completed and the lift gates tested and found to be satisfactory.

The cofferdams at the upper and lower ends of the lock were left intact to be used during erection of the miter gates.

About all that remains to be done on this contract is the removal of the cableway beams and placing the material in the bank along the east side of the lock, and the construction of a footbridge across Deep Run.

BRANDON ROAD POOL, CONTRACT NO. 6.

The survey for the location of the river wall under this contract was completed and the faces of the walls staked out. The contract was advertised a second time but all bids were rejected again.

BRANDON ROAD LOCK AND DAM, CONTRACT NO. 5.

It was decided to include the miter gates and all other steel work except operating machinery in this contract and the necessary drawings were made. The specifications were partly rewritten to include this but were not finished. The set of drawings was not quite completed.

DRESDEN ISLAND LOCK AND DAM, CONTRACT NO. 3.

It was decided to include the miter gates, taintor gates, ice chute gate, head gates and operating bridge, and all other steel work except operating machinery in this contract. This necessitated several additional drawings and a rewriting of the specifications. This additional work was just begun.

MARSEILLES DAM.

No work was done during the year.

MARSEILLES CANAL.

No work was done during the year.

MARSEILLES LOCK.

A careful survey of the lock was made to determine the exact location of the top of the reaction bearings. These were found to be slightly out of position but apparently not sufficiently so to cause great difficulty in adjusting the quoin bearing pieces.

Miter lock gate construction at Lockport, June 20, 1927. These gates are 55 feet wide, nearly 65 feet high, and weight 315 tons each. They will be operated by electricity, and are the highest gates of this type in the world.

STARVED ROCK LOCK AND DAM, CONTRACT NO. 2.

Work was continued on this contract on the lock and headgate structure. The steel work has all been fabricated and delivered at the site. Considerable delay has been caused by high water in the river.

LOCK GATES AND ANCHORAGES, CONTRACT NO. 4D.

Work was started on the fabrication of the gates for this contract early in the year and erection of the Lockport gates started about the middle of April.

The inspection and testing of materials was done by the Designing Department, which also maintained a general supervision of inspection of fabrication. Considerable difficulty was experienced in fitting parts together due to the fact that there were several different firms engaged in the manufacture of the various members that had to be fitted together. There also seemed to be a lack of cooperation between the different firms engaged in the work.

ILLINOIS AND MICHIGAN CANAL.

OTTAWA AND LASALLE AQUEDUCTS.

A combination sandblasting, air compressing and paint spraying outfit was purchased for general use. Some portions of the Ottawa Aqueduct were cleaned and painted in the spring but it became necessary to suspend the work so that the canal could be thrown open to traffic.

AUX SABLE AQUEDUCT.

In June, 1927, a break occurred in the Aux Sable Aqueduct due to flood conditions. A portion of the floor was carried away. On careful inspection several floor beams were found to be broken at various places in the aqueduct and the whole structure was found to be so badly decayed that it was decided to put in temporary repairs and recommend that a steel aqueduct similar to the one at Ottawa be built as soon as possible.

BREAKS IN CANAL BANKS.

In September, 1926, a break occurred in the south bank of the canal between locks Nos. 11 and 12 at the same place that break occurred two years before. It was realized that if this break were closed without a spillway being constructed somewhere in this level of the canal it will only be a matter of a short time before another break will occur as this pool is only about one mile long and two streams enter it from the north side. Therefore, when the break was repaired a spillway was constructed alongside lock No. 12.

In June, 1927, another break occurred in the south bank of the canal about two miles below Joliet. This break was filled by hauling material from nearby and dumping it into that gap.

COLUMBUS STREET BRIDGE, OTTAWA.

Plans for this bridge were completed and the contract let to the Milwaukee Bridge Company of Milwaukee, Wisconsin. During construction it was found that the concrete of the abutments and pier was in much worse condition than supposed and, therefore, a great deal more

concrete had to be built than it was thought would be necessary when the estimate of cost was made. This increased the cost of the bridge to considerably more than estimated. At the end of the year the bridge was complete except for the installing of the end lift and latch machinery.

CLARKE'S RUN CULVERT, UTICA.

A design in sufficient detail for an estimate of cost was made for a culvert at this place.

MATCHTOWN CULVERT, MARSEILLES.

Modifications were made in the design of this culvert some time ago and it was constructed utilizing the old foundation.

MISCELLANEOUS.

BEARDSTOWN FLOOD PROTECTION.

Drawings and specifications were prepared for retaining walls and levees to protect Beardstown from flood waters, and the contract was awarded and is now in process of construction.

CHANGE IN OFFICE.

In June, 1927, the office of the Division of Waterways was moved from Room 950, 608 South Dearborn Street to Room 1510, 220 South State Street.

PERMITS ISSUED.

ANNUAL REPORT OF W. G. POTTER, DRAINAGE ENGINEER.

During the year from July 1st, 1926 to June 30th, 1927, inclusive, the following permits were issued by this division:

FORMAL PERMITS.

Docks, piers, retaining walls, etc.	57
Sewer system or treatment plant	39
Tunnels, pipe lines and transmission lines crossing streams	40
Dredging and filling	14
Bridges	43
Chicago River change of channel	1
Harbors, water intakes and discharges	11
Dams	4
Drainage Districts	3
Total formal permits	212
Letter permits, piers, channels, etc., for Fox Lake Region	25
Bridges and Culverts on weekly list from Division of Highways	461
Total number of permits issued	698

EXCESSIVE RAINS IN ILLINOIS VALLEY

August 29 to October 5, 1926.

By W. G. Potter.

Excessive rains in the fall of the year are rather unusual in Illinois. For that reason a short description of the rainfall of August to October, 1926, is worthy of record.

Including the 38 days from August 29th to October 5th, 1926, the rainfall over the central part of Illinois far exceeded any past record. Therefore, the writer has made a study of the extent and amount of precipitation during that period.

OFFICIAL RECORD CONSULTED.

The figures here given for rainfall are taken from the U. S. Weather Bulletin, and also partly from the excellent paper of Mr. Clarence J. Root, Meteorologist of the U. S. Weather Bureau at Springfield, Illinois, as read before the Illinois Society of Engineers.

The early part of August, 1926, was wet, the rainfall considerably exceeding the normal. The ground was pretty well saturated and the harvesting of grain was much delayed. Towards the end of the month, beginning on August 29th and ending on September 5th, occurred a general rain of great intensity. Rain to the depth of 3 to 6 inches in 24 hours fell in many places.

Again on the 8th and 9th, rains approaching deluge intensity covered the central belt of the State. At Griggsville 6.06 inches fell in 13¼ hours; at Alexander 7.02 inches and at Charleston 8 inches in 24 hours. At Springfield 3 inches fell in 2 hours with a total in the 6 day period from September 3rd to 8th of 10.83 inches. This is the record for Springfield and has only been exceeded twice on the record of an entire month.

RAINFALL ON ILLINOIS RIVER WATERSHED AUGUST 29 TO OCTOBER 5, 1926.

Station.	River.	Rainfall inches.	Normal annual.	Per cent of annual.	Per cent for river.
Joliet	DesPlaines	7.68	32.08	23.9	23.9
Aurora	Fox	8.73	34.79	25.1	
Elgin	do	9.80	30.14	32.5	28.8
Kankakee	Kankakee	12.37	32.07	38.6	38.6
Pontiac	Vermilion	13.50	31.22	43.2	43.2
Ottawa	Illinois	15.22	33.42	45.5	
Tiskilwa	do	11.10	35.68	31.1	
Walnut	do	14.59	33.10	44.1	
Fairview	do	15.07	30.72	49.1	
Grafton	do	13.51	37.18	36.3	
Griggsville	do	21.91	35.86	61.1	
Havana	do	12.36	34.10	36.2	
Whitehall	do	20.21	36.64	55.2	
Peoria	do	16.53	36.29	45.5	
Pearl	do	22.17	37.79	58.7	
Minonk	do	14.86	31.24	47.6	
LaSalle	do	13.18	31.41	42.0	
Henry	do	13.40	33.26	40.3	
Astoria	do	11.94	35.15	33.9	
Beardstown	do	14.87	34.01	43.7	
Ottawa	do	15.22	33.42	45.5	
Dwight	do	12.58	32.79	38.4	
Morris	do	10.67	29.24	36.5	43.9
LaHarpe	Crooked Creek	12.10	36.21	33.4	
Macomb	do	12.34	33.84	36.5	
Rushville	do	15.12	34.01	44.5	38.1
Clinton	Salt Creek	22.48	36.90	60.9	
Lincoln	do	16.95	34.49	49.1	
Bloomington	do	17.65	36.07	48.9	53.0
Decatur	Sangamon	23.32	35.40	65.9	
Springfield	do	20.52	36.96	55.5	60.7
All stations	Illinois watershed	14.92	34.05	43.8	43.8

Again on September 12th to 15th another storm occurred but of lesser intensity. Then to cap the climax, from September 22nd to October 5th, rain fell almost continuously, being extremely heavy during the last few days.

FIG. 1.—Chart showing the boundaries of sections, location of principal reporting stations, river systems, and general elevation above sea level.

MOST REMARKABLE STORM PERIOD.

These heavy storms coming in so short a time as 38 days, combined to form the most remarkable storm period on record in Illinois.

The writer has tabulated the rainfall during this period for all weather bureau stations on the Illinois and its tributaries, as shown

herewith. This chart shows the total rain on each main tributary and on the entire Illinois valley; the normal annual rainfall and the percentage of that normal which fell during this period.

Noticeable in the chart is the fact that the rain over the upper tributaries was comparatively light, and that it increased towards the south until on the Sangamon 60.7 per cent of the normal annual fell during the 38 day period. The entire Illinois Valley, by averaging the 31 stations, showed 43.8 per cent of the normal annual.

In consequence of these unprecedented rains, rivers all through Central Illinois were at flood stages, and great damage was general. Several dams burst, adding the reservoir waters and increasing the damage. One railroad, in a distance of 140 miles, had 16 bridges washed out or damaged and three heavy track washouts.

While this flooded condition was general, the greatest damage was sustained along the Illinois River and its tributaries. For that reason this report is devoted to the Illinois River watershed alone.

THE ILLINOIS RIVER WATERSHED.

The Illinois River is formed by the junction of the Fox, Des-Plaines and Kankakee rivers in the northeastern part of the State. Its course is generally southwest, and it enters the Mississippi about 40 miles above St. Louis. Tributary streams, mostly draining the central belt of the State, are the Spoon, Mackinaw, Crooked Creek and Sangamon.

The great physical characteristic of the Illinois is the abrupt change near LaSalle from a stream of very rapid descent, largely through rocky bottom, to a sluggish one with but little fall. On the lower 200 miles of its course, the stream winds back and forth with many twists and bends.

DRAINAGE DISTRICTS EMBRACE 1,550,000 ACRES.

The Illinois Valley varies from two to ten miles in width and was originally largely covered by lakes and swamps. Much of this low ground, which is very rich and fertile, has been reclaimed by building levees along the river and pumping out the impounded water. On the main river 69 drainage districts have been organized, reclaiming some 320,000 acres, and about ten other districts are in process of organization. On the various tributaries some 350 districts have been organized. The total area on the Illinois and its tributaries now in drainage districts is about 1,550,000 acres, the average per district being about 4,440 acres.

In consequence of this long period of excessive rain, 23 districts on the Illinois alone were inundated either by the levees being overtopped or broken. About 100,000 acres were flooded in these districts and many more which were in cultivation, but not in districts.

The principal crops, being corn and small grains, and being either mature or already harvested but still in the field, were entirely destroyed. The loss in the Illinois valley alone was estimated at $2,700,000; for damage to crops below the high water line. This does not include damage to buildings in farm or city, nor does it include damage incurred above the actual flood line.

CALAMITY NOT CONFINED TO FARMS.

Turning from farm to city property, the greatest damage was done in the city of Beardstown. This is a city of about 7,000 population located mostly on low ground on the banks of the Illinois. Low water on the river is normally about at an 8-foot stage on the gauge. At the crest of the 1922 flood, the gauge showed 25.1 and in 1926 the flood now being considered, the water rose to 26.6, the highest on record. About nine-tenths of the town was under water, some of it up to 10 feet or more. The town was completely surrounded by water. No actual money value has been or could accurately be put on the damage sustained in this town. Other towns partly inundated and subjected to heavy damage were Liverpool, Havana, Bath, Frederick, Naples and Valley City.

In consequence of this flood many of the districts are still partly under water and will be unable to raise crops this coming season. Several districts, having gone through both the 1922 flood and the 1926 flood, are unable to tax the property high enough to make repairs, and many farms will be lost to their owners because of their inability to make payments due for taxes on land.

ILLINOIS AND MICHIGAN CANAL REPORT.

By John A. Walter, *Auditor.*

SUMMARY SPECIAL CANAL FUND

and

Activity Report July 1, 1926, to June 30, 1927.

Balance on hand July 1, 1926		$56,644.12
Expenditures July 1, 1926, to June 30, 1927	$39,162.96	
Receipts July 1, 1926, to June 30, 1927	35,788.51	
Expenditures over receipts		3,374.45
Balance on hand July 1, 1927		$53,269.67

RECEIPTS.

July 1, 1926, to June 30, 1927.

90 foot strip, lots and bridge rentals	$16,044.83
Water power rentals	12,492.24
Boat house rentals	35.00
Water pipe rentals and miscellaneous	6,266.91
Ice leases	795.00
Certified copies	20.00
Tolls and lockages	134.53
Total	$35,788.51

EXPENDITURES.

July 1, 1926, to June 30, 1927.

Appropriation for Illinois and Michigan Canal	$39,162.96
Appropriation for Illinois River	25,794.98
Appropriation for Bridge at Columbus Street, Ottawa	25,000.00
Appropriation for Culverts at Marseilles, Illinois	18,128.45

ILLINOIS AND MICHIGAN CANAL EXPENDITURES.

July 1, 1926, to June 30, 1927.

Salary locktenders and officers	$ 8,820.00
Labor pay rolls	14,914.45
Repairing gap in banks west of Lock 11	6,116.16
Repairs	362.56
Maintenance and operation	3,564.79
Equipment	29.15
Two new spillways at Lock 12	5,355.85
Total expenditures	$39,162.96

MAINTENANCE NAVIGATION ILLINOIS RIVER EXPENDITURES.

July 1, 1926, to June 30, 1927.

Salary locktenders, collectors and inspectors	$ 5,300.00
Labor pay rolls	7,799.95
Repairs	2,963.80
Maintenance and operation	4,386.39
Dredging at Bell's Landing	1,000.00
Dredging at Copperas Creek Lock	802.79
Equipment	3,542.05
Total expenditures	$25,794.98

Number of boats running, tolls and lockage collected, and tons transported on the Illinois and Michigan Canal and through Henry and Copperas Creek Locks for period July 1, 1926, to June 30, 1927

	Copperas Creek	Henry	Joliet	LaSalle	Total
Tolls and lockages	$13.82		$87.34	$33.37	$134.53
Boats cleared	7		38	13	58
Tons transported	662				662

Statement of the principal articles transported upon the Illinois River, cleared at Collector's office at Locks, at Henry and Copperas Creek, for the year ending June 30, 1927.

Articles	Measure	Copperas Creek	Henry	Total
Wheat	bushels	8,000		8,000

ACTIVITY REPORT.

July 1, 1926, to June 30, 1927.

Decreased receipts due to reduction in tolls and lockages caused by flood damages which prevented navigation on the canal, and high water in the Illinois River so that traffic boats did not use the river locks but passed over the dams at Henry and Copperas Creek locks, also there was received the previous year $4,750.00 as part payment on spillway dam at Pecumsasgen.

Expenditures increased $10,838.62 over previous year due to permanent improvements and repair of flood damages. There has been constructed two new concrete spillways one east and one west of Lock 12 in LaSalle County at cost of $5,355.85. On September 23, 1926 excessive rain falls and floods caused a break in the towpath west of Lock 11 which cost $6,116.16 to repair, and east of Lock 12 for a distance of three hundred feet the channel was filled with tile, brick and debris and at Higby Canyon a sand bar seven hundred fifty feet long formed in the channel, these fills were removed by the State dredge outfit.

On June 4, 1927 there was an unusual rain fall, Rock Run and all other creeks that empty into the canal were out of their banks, the canal not able to take care of the large amount of water and the banks overflowed near Bush Bridge, which caused a break in the towpath sixty-five feet long, sixteen feet deep and which will take until last of July to repair, the same floods washed out twenty feet of the flooring on west end of Aux Sable aqueduct which was promptly repaired by our regular crew.

Up to date of this report (June 30, 1927) navigation has not yet been opened due to construction of a new culvert across canal at Matchtown, sand blasting and painting of aqueduct over the Fox River at Ottawa, and bars in the channel west of Ottawa.

Thirteen new leases for strips of canal reserve and two pole line leases were made, and nine certified copies of land and lot sale books furnished. Canal reserve and Feeder reserve in sections 30, 31 and 36 leased and lease contained the usual cancellation clause. One boat house lease cancelled and structure removed. Rental on two houses at Levee Street were increased.

Permits issued to Public Service Company for transmission line across canal at Van Buren Street, Joliet; Telephone Company for conduit at LaSalle Street, Ottawa; and Ottawa Silica Company to extend their dyke along canal west of Lock 11; sewer and bridge across canal at Forty-eighth and Cicero Avenues.

Illinois Bell Telephone Company removed part of their poles in LaSalle County that were on canal reserve and recount has been made of remaining poles.

Locktenders' telephones in LaSalle County were transferred to local exchanges thereby making a saving in toll charges.

New bridge across canal at Columbus Street, Ottawa, and new culvert at Matchtown were constructed.

Seventeen racing boats from Chicago to New Orleans went through the canal from Channahon to Marseilles where they entered the Illinois River.

In September, 1926 the Standard Unit Navigation Company power boat with two loaded barges made trip from LaSalle to Joliet and in November they returned to LaSalle.

Nineteen test plates of steel and paints have been submerged in canal at Jackson Street lock for testing purposes.

Hearings were held at Morris and Ottawa by Court of Claims in connection with flood damage claims of 1924 and 1926.

Sandblasting and paint spray outfit purchased and the interior of Ottawa aqueduct has been sand blasted and painted two coats of red lead.

Waste weir and gates east of Brandon bridge were rebuilt and new snubbing posts installed at all the locks.

The Rock Island Railway reinforced their wall along the canal at Split Rock.

Painted and repaired all the State buildings at Copperas Creek Lock.

Repaired, reinforced and painted lock gates and built up the dyke at Henry Lock.

Up to June 30th this season we have dredged, repaired banks and cleared the channel between Joliet and Lock 11 which is west of Ottawa to permit boats with three feet six inch draft to get through; it will take about twenty more days to clear the channel between Lock 11 and the river at LaSalle. It is the intent to continue dredging, repairing and raising canal banks between LaSalle and Marseilles until October 15th, and then continue same kind of work between Channahon and Joliet.

The United States dredging outfit cleared out the approaches to, and chamber of the lock at Copperas Creek.

A private dredging outfit was used to dredge a channel from the Illinois River to the elevator at Bell's Landing in Fulton County.

PUBLICATIONS FOR DISTRIBUTION BY THE DIVISION OF WATERWAYS.

Issued by the Rivers and Lakes Commission of Illinois 1911-1916.

* * *

BULLETINS.

No. 1 The Conservation of Water Power in the DesPlaines and Illinois Rivers and the Improvement of these Rivers for Navigation—1911.

No. 2 Prospectus of a project for a Deep Waterway and conservation of a natural resources of the State of Illinois, prepared by Lyman E. Cooley —1911.

No. 3 Uses of the Great Lakes—1912.

No. 4* Land Drainage in Illinois, by Robert Isham Randolph—1913.

No. 5 A compilation of money spent by the Government on various Harbors, Rivers and Canals, and the riparian property holders benefited—1912.

No. 6 Argument on behalf of the State of Illinois supporting the prayer of the Sanitary District of Chicago for a permit to take 10,000 cubic feet of water per second from Lake Michigan, by Isham Randolph—1912.

No. 7* The 1912 Flood on the Lower Mississippi, by A. L. Dabney, Consulting Engineer, and "The 1912 Flood in the Ohio and Mississippi Rivers," by H. C. Frankenfeld—1912.

No. 8 Proceedings of the organization meeting of the Association of the Mississippi Valley States for river control—1912.

No. 9 The Illinois Water Power Waterway—1912.

No. 10 The Illinois Waterway—A Guide for Navigators from Lake Michigan to the Mississippi River via the Chicago Sanitary and Ship Canal, the Illinois and Michigan Canal and the Illinois River. Also an Alternate Route via the Illinois and Mississippi Canal—1916. (New edition in preparation.)

No. 11* European Harbor Development, by Robert R. McCormick—1912.

No. 12* Common Sense applied to the Inland Waterway Problem, by Robert R. McCormick—1912.

No. 13 The Illinois Waterway, A Review, by Isham Randolph—1912.

No. 14 Water Resources of Illinois—A cooperative report prepared by Rivers and Lakes Commission and A. H. Horton, District Engineer of the United States Geological Survey—1914.

No. 15* The Illinois Waterway—A Project for a waterway of eight feet minimum depth between Lockport and Utica and available for immediate construction—1914.

No. 16 Stream Pollution and Sewage Disposal in Illinois with reference to public Policy and Legislation, by LeRoy K. Sherman—1915.

No. 17* Report of Survey and investigation of La Moine River, with Reference to Flood Control and Navigation.

No. 18* Flood Control for Pecatonica River—1916.

No. 19* Project for a Navigable Waterway from Southern Illinois Coal Fields to Mississippi River—1917.

No. 20* The Illinois Waterway Report with plans and estimates of cost for a deep waterway from Lockport to Utica by way of the DesPlaines and Illinois Rivers, Internal Improvement Commission—1909.

No. 21* Surface Water Supply of Illinois, Internal Improvement Commission—1908—1910.

No. 22 Report and (Plans*) for reclamation of lands subject to overflow in the Kaskaskia River Valley, Illinois—1910—1911. Postage 16 cents.

No. 23 Report upon the prevention of overflow of the Little Wabash and Skillet Fork Rivers—1911. Postage 16 cents.

No. 24 The Illinois River and its Bottom Lands, by Alvord and Burdick—1915. 2nd Edition 1919.

*Map and Profile of Fox River—1915.

Annual reports of Rivers and Lakes Commission 1912*—1913—1914—1915*—1916.*

ISSUED BY THE

DIVISION OF WATERWAYS

SUCCESSOR TO RIVERS AND LAKES COMMISSION.

*First annual report—1917-18.

Second, Third, Fourth, Fifth, Sxith, Seventh, Eighth and Ninth Annual Reports 1918-26.

Saline River report 1920 (See Third Annual Report).

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* On file in office of Division of Waterways, Chicago. Supply for distribution exhausted.

Inland Waterways and Transportation cost by M. G. Barnes, 1920.

No. 25 Big Muddy River Report 1922—(Also in Fifth annual report).

No. 25½ Floods in Illinois 1922—causes, results and remedies (Also in Fifth Annual Report.)

Pecatonica River report—1924 (See Seventh Annual Report.)

Report of the Interstate Harbor Commission of Illinois and Indiana on Harbor and Terminal Development at the State line between Illinois and Indiana and in Chicago Industrial District—1922.

No. 26 Calumet Lake and Chicago-Nickle Plate Agreement—1926.

No. 27 Laws of Illinois relating to Waterways.

No. 28. National Aspects of Lakes to Gulf Waterway—Diversion of waters from Lake Michigan—Boundary Waters Treaty, etc.

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* On file in office of Division of Waterways, Chicago. Supply for distribution exhausted.

FOR ANY OF THE FOREGOING PUBLICATIONS, ADDRESS WM. F. MULVIHILL, DIVISION OF WATERWAYS, 220 SOUTH STATE STREET, CHICAGO, ILL.

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ELEVENTH ANNUAL REPORT

OF

DIVISION OF WATERWAYS

OF

THE DEPARTMENT OF PURCHASES AND CONSTRUCTION

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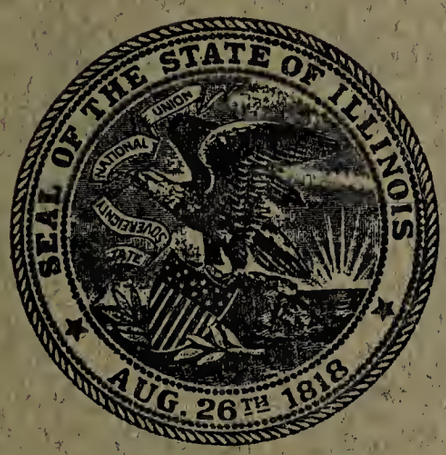
TO

June 30, 1928



LESLIE SMALL, Director

WILLIAM F. MULVIHILL,
Supervisor of Illinois Waterway Construction

L. D. CORNISH, Chief Engineer

Chicago Office, 220 S. State St.

[Reprinted from the Eleventh Administrative Report. Printed by authority of the State of Illinois.]

387
1462
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Journal Printing Company
Springfield, Illinois
1929

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WATERWAYS.

Wm. F. Mulvihill,
Supervisor Illinois Waterway Construction.

The Eleventh Annual Report of the Division of Waterways covers the principal activities of the Division from July 1, 1927, to June 30, 1928.

As was stated in the Tenth Annual Report, the Division of Waterways was transferred, July 1, 1925, from the Department of Public Works and Buildings, and became a part of the newly created Department of Purchases and Construction, of which Mr. Leslie Small was appointed Director. The present Supervisor of Waterway Construction was appointed as Superintendent of Waterways, September 2, 1925, and to his present position July 14, 1927, the title of the office having been changed by the Fifty-fifth General Assembly.

JURISDICTION OF DEPARTMENT.

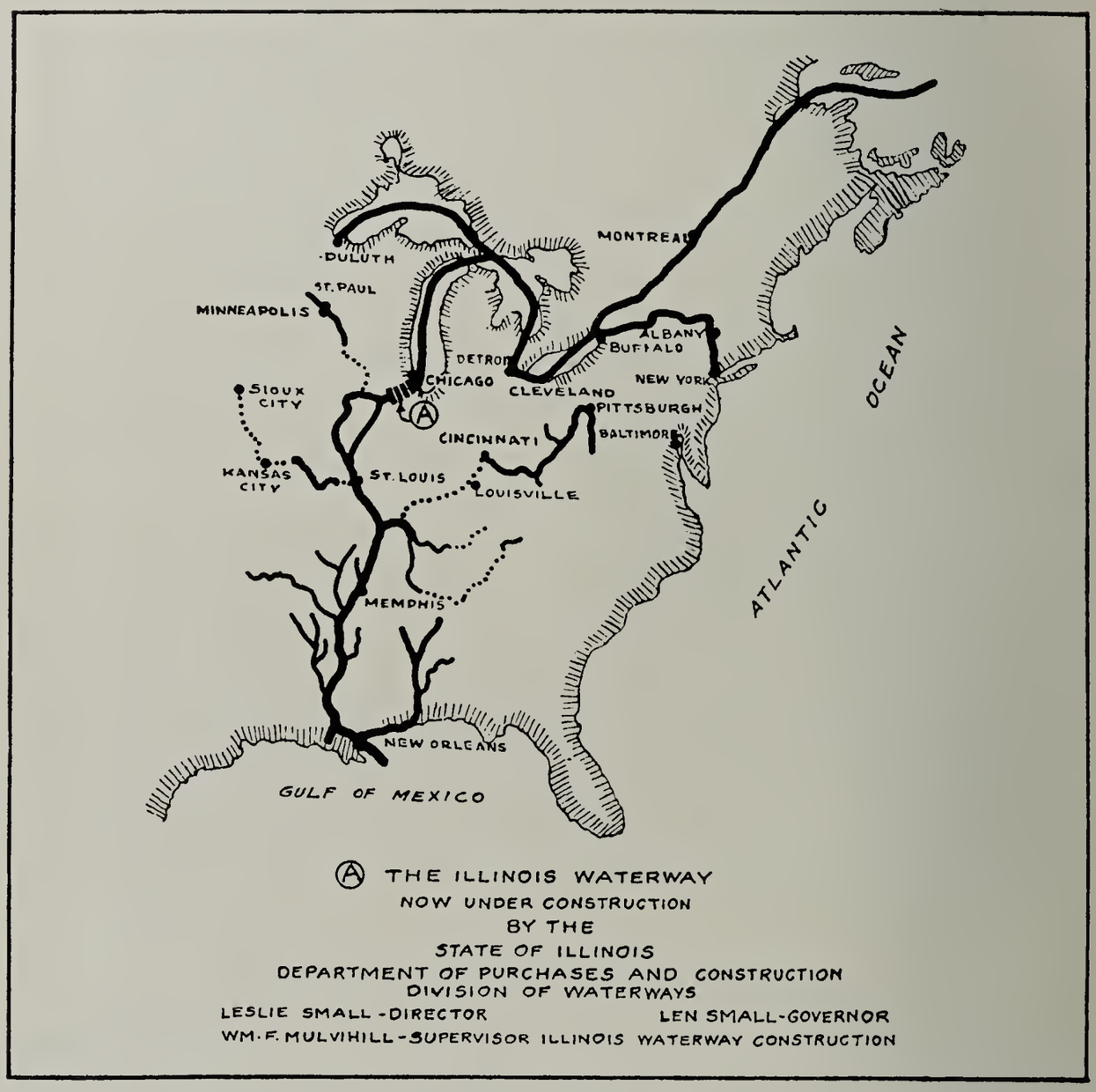
The law confers upon the Department the powers, duties and jurisdiction formerly exercised by the Rivers and Lakes Commission, with especial reference to its jurisdiction over all rivers and lakes of the State of Illinois, to prevent pollution thereof or encroachments thereon; the powers and duties of the Illinois Waterway Commission, with reference to the construction, operation and maintenance of the Illinois Waterway, and for the development and utilization of the water power thereof; and also the powers of the Illinois and Michigan Canal Commissioners, for the control and management of the Illinois and Michigan Canal, the maintenance of the navigability thereof and the sale and lease of canal lands and property.

A YEAR OF CONSTRUCTIVE ACHIEVEMENT.

The fiscal year ending June 30, 1928, witnessed the carrying forward of the greatest construction program in the history of the Division. The appropriations to the Division for the biennium, July 1, 1927, to June 30, 1929, amounted to $19,253,813. This included $16,674,500 for Illinois Waterway Construction; $1,500,000 for Emergency Relief in Flood Areas, and a reappropriation of the unexpended balance of $350,000 for protection of the city of Beardstown from overflow of the Illinois River. During the past year the expenditures have amounted to $4,232,814, of which $2,827,553 was for Waterway construction, $822,345 for Emergency Flood Relief and $349,138 for Beardstown Sea Wall and Levees. The expenditures for Flood Relief work, alone, exceeded by $20,000 the largest previous expenditure of the Division for waterway purposes prior to 1927.

WATERWAY WORK STARTED AMOUNTS TO $7,000,000.

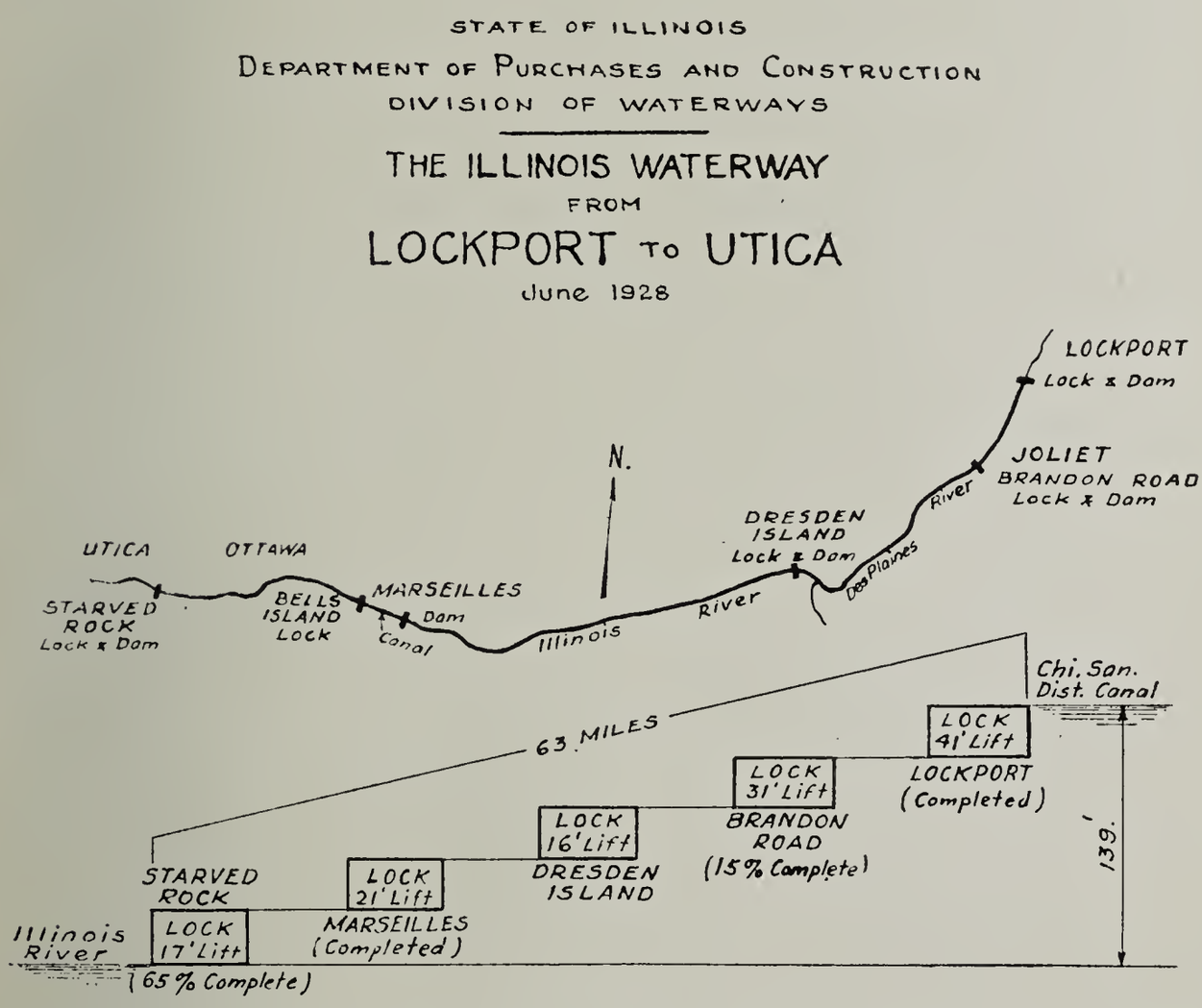
During the last fiscal year the total estimated cost of contracts awarded or work put under construction by the Division, excluding over $900,000 paid for right-of-way, amounted to over $6,936,000—which sum exceeds the total expenditures of the Division during the ten years of its previous history. The overhead or operating expense of the Division was



This map shows two great systems of inland waterways, the Great Lakes System and the Mississippi Valley System. "The Illinois Waterways," now being constructed by the State of Illinois at a cost of $20,000,000 is the connecting link between these two systems. Its completion, fixed, for April 1, 1931, will afford a 9-foot navigable channel from Chicago to New Orleans.

at the same time proportionately decreased. The contracts let and construction work started during the past year include 100 emergency flood relief contracts, Beardstown sea wall and levee contracts, the construction by the Division itself of Brandon Road lock, dam and retaining walls of the Illinois Waterway and contracts for the lock gates and metal work of Starved Rock lock and dam.

Sealed proposals for excavating in Starved Rock Pool, Marseilles Canal, Dresden Island Pool and Brandon Road Pool will be opened July 18, 1928. Advertisements for lock gates for Brandon Road and Dresden Island projects and for operating machinery at all locks have been pre-



pared and it is expected proposals will be received within the next sixty days.

The following tabulation shows the "Expenditures from the Waterway Fund" since the creation thereof in 1920 to the end of the current fiscal year:

EXPENDITURES FROM THE ILLINOIS WATERWAY FUND FROM OCTOBER 19, 1920, TO JUNE 30, 1928.

Fiscal years ending June 30.	Total structures, including labor.	Total cement for structure.	Total salaries—wages, Chicago office.	Total salaries—wages, field.	Total office expense.	Total equipment and supplies.	Total land and property damage.	Total miscellaneous and incidental expense.	Total travel expenses.	Yearly total.
1921	$ 182,752 49		$ 20,770 00	$ 7,720 00			$ 92,671 95			$ 303,914 44
1922	430,896 93		35,505 57	26,283 91	$4,057 59	$ 78 55	$ 145 30	$ 539 79	$1,675 01	499,182 65
1923	604,502 59		56,005 20	10,222 66	708 55	92 78	2,229 65	3,165 02	4,313 26	681,239 71
1924	170,833 02		69,063 78	431 44	681 30	23 50	39,484 60	1,011 36	1,607 65	283,136 65
1925	311,521 78	$ 39,440 70	39,163 87		1,711 56		14,958 20	204 30	299 94	407,300 35
1926	585,813 30	121,079 40	44,427 38	3,259 40	699 91	414 81	37,808 80	5,810 13	3,272 27	802,585 40
1927	905,104 42	94,344 50	74,174 28		761 75	349 77		7,277 28	3,027 24	1,085,039 24
1928	1,580,539 55	185,437 20	122,555 02		700 40	594 70	902,941 20	28,758 34	6,027 18	2,827,553 59
Total to June 30, 1928	$4,771,964 08	$440,301 80	$461,665 10	$47,917 41	$9,321 06	$1,554 11	$1,090,239 70	$46,766 22	$20,222 55	$6,889,952 03

EMERGENCY FLOOD RELIEF.

The Emergency Flood Relief Act (Senate Bill 576) approved July 7, 1927, appropriated $1,500,000 to furnish emergency relief in the areas in Illinois, which by reason of the abnormal weather conditions of 1926-1927 had been submerged, or damaged by floods and for the repair and reinforcement of levees which had been or were in danger of being damaged by flood waters.

The carrying out of the provisions of this emergency flood relief law devolved upon the Division of Waterways. The magnitude of this task will be appreciated when it is remembered that the 1926 flood on the Sangamon and Illinois Rivers occurred during the crop season and exceeded all prior floods as to flood heights and damage to property, and that it continued for 42 days on the Sangamon and for 66 days on the Illinois.

The 1927 flood followed so close upon that of 1926 as to be almost a continuation of the same. It continued for 109 days on the Sangamon, 151 days on the Illinois and for 33 days on the Mississippi at East St. Louis and for 75 days at Cairo.

WATER 15 FEET DEEP ON FARMS.

The depth of water on drainage and levee district land in some cases was as great as 15 feet. Some of the land was under water for a period of nearly two years owing to the inability of the owners to repair the levees. The principal areas flooded were farm lands which had been reclaimed by levees, and were very productive. In all, more than 400,000 acres of land in drainage districts were submerged, with a direct, traceable damage of more than $18,000,000.

DIVISION HANDLES 100 EMERGENCY RELIEF CONTRACTS.

Estimates for the rebuilding and strengthening of broken and damaged levees, made by engineers and trustees of the levee and drainage districts seeking emergency flood relief, placed the cost of the work to be done in excess of $2,000,000. By thoroughly organizing its emergency flood relief work, it has been possible for the Division of Waterways to care for substantially the entire relief provided for by the law, at a total cost well within the appropriation of $1,500,000 made by the General Assembly.

For the prosecution of this work it was necessary to organize an entirely new field force of engineers, surveyors and inspectors. Headquarters were located at Beardstown for the Illinois Valley Division, and at Anna for the Mississippi Valley work. A total of 100 separate contracts were awarded, aggregating $912,313. Other contracts are being negotiated.

SAVING BEARDSTOWN FROM FUTURE FLOODS.

The city of Beardstown is on the east bank of the Illinois River about 70 miles below Peoria and about 90 miles from Grafton, where the Illinois discharges its waters into the Mississippi. The land on which the city is built was originally several feet above ordinary high water stages of the river, but, owing in part at least to the extensive

construction of levees for reclamation of lands in the river bottoms which reduced the flood flow sections of the river, and due in part, as is claimed by many local residents, to the diversion into the Illinois Valley of water from Lake Michigan by the Sanitary District of Chicago and to the effect of the Government dams at Kampsville and LaGrange, the flood stages in recent years have risen to such height that the city has been almost completely inundated four times since 1922.

GENERAL ASSEMBLY APPROPRIATED $350,000.

Presumably because the levee and drainage districts have been created under authority of law, and since no one district could be held responsible for the lessening of the natural overflow areas, and, also, because its limited bonding power made it impossible for the city to protect itself from overflow of the Illinois River, the General Assembly in 1923 appropriated $350,000 for Beardstown flood protection. This sum lacked $46,000 of being sufficient to build adequate walls and levees, according to estimates made by engineers for the Division of Waterways, and therefore no contract could be let. This $350,000 was reappropriated in 1925. In 1927, the Chicago, Burlington and Quincy and the Baltimore and Ohio railroads having arranged to supply the needed $46,000 additional funds, plans and specifications were drawn and bids received prior to the adjournment of the Fifty-fifth General Assembly, June 30, 1927. Contracts were awarded to the low bidders, James O. Heyworth, Inc., for the concrete wall and to McWilliams Dredging Company for the earth levees, as soon as the reappropriation bill had been approved.

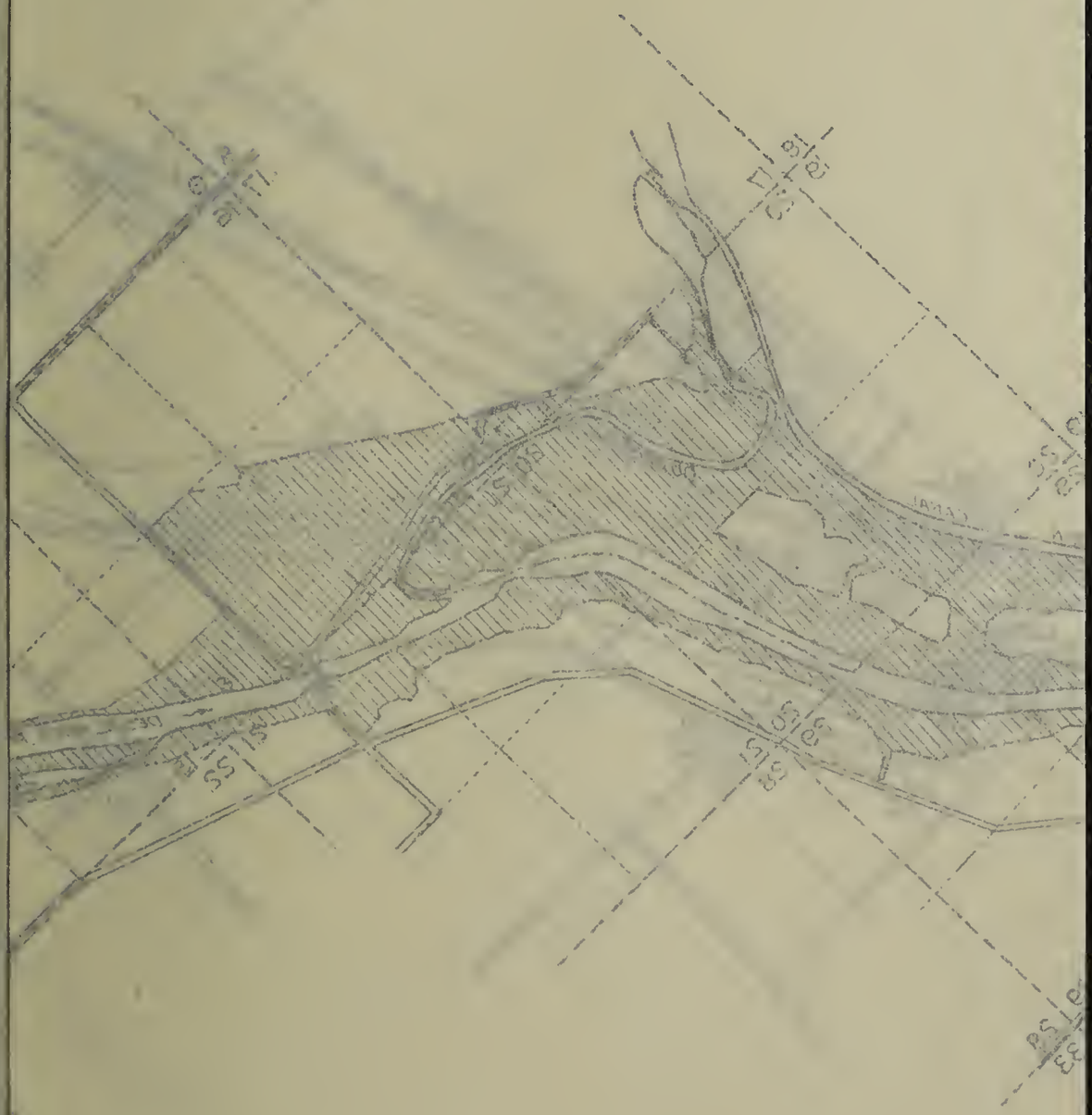
A right-of-way committee of the Beardstown Chamber of Commerce, at a cost of $22,976, secured 110 separate pieces of property on which to construct the wall and levees, condemnation proceedings being necessary in eleven cases.

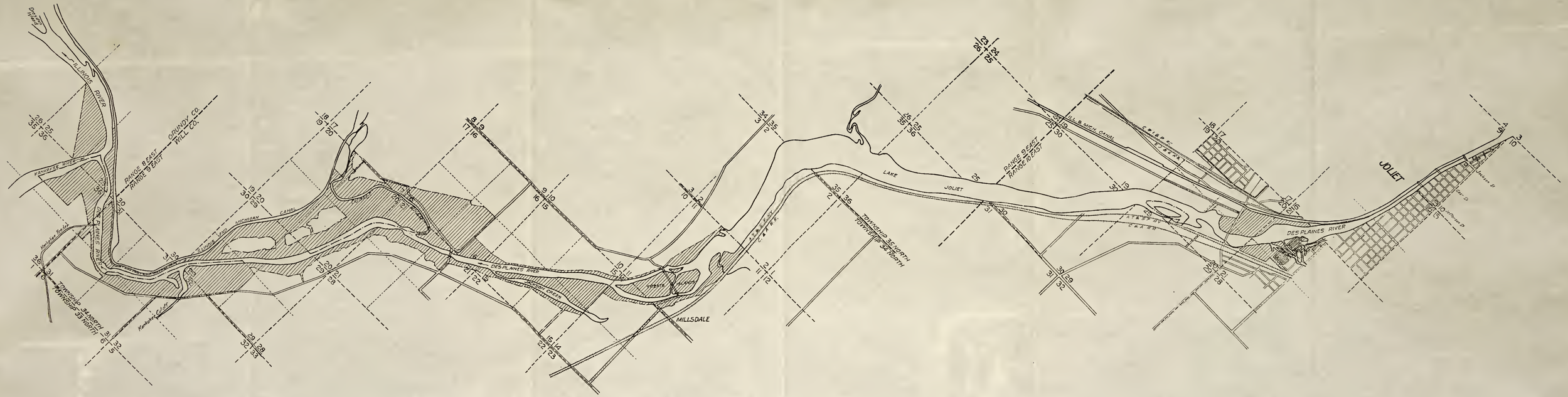
WILL PROTECT CITY AGAINST 30-FOOT FLOOD STAGE.

The concrete wall along the river front is over 3,000 feet in length. From Clay to Jackson streets the wall rests on more than 2,000 wood piles driven in the earth 20 feet and projecting 5 feet into the concrete, locking it firmly. That portion of the wall resting on piling is 22 feet high with a 10-foot 3-inch base tapering to a 2-foot top. The entire wall will protect the city from a flood stage of 27.75 feet. The top is equipped so that an additional 2 feet of flash boards may be quickly put in place.

Connecting with the ends of the concrete wall are earth levees about two miles long protecting against a 31.75 foot flood stage. These levees are 10 feet wide at the top with a three to one slope. More than 500,000 cubic yards of earth was required to build the levees.

The space enclosed by the protective works, being much larger than the city itself, the entire area has been organized into a Sanitary District, the people residing in the territory voting bonds in the amount of $200,000 to raise money for storm sewers and pumping plants which it was necessary to build to care for the rain and seepage water during high water periods. The entire work was completed during the fiscal year.





Shaded portions indicate lands acquired by the State from the Public Service Company of Northern Illinois, lying between Joliet and Dresden Island. When the Dresden Island Lock and Dam of the Illinois Waterway are completed and water levels are raised, this land will be submerged.

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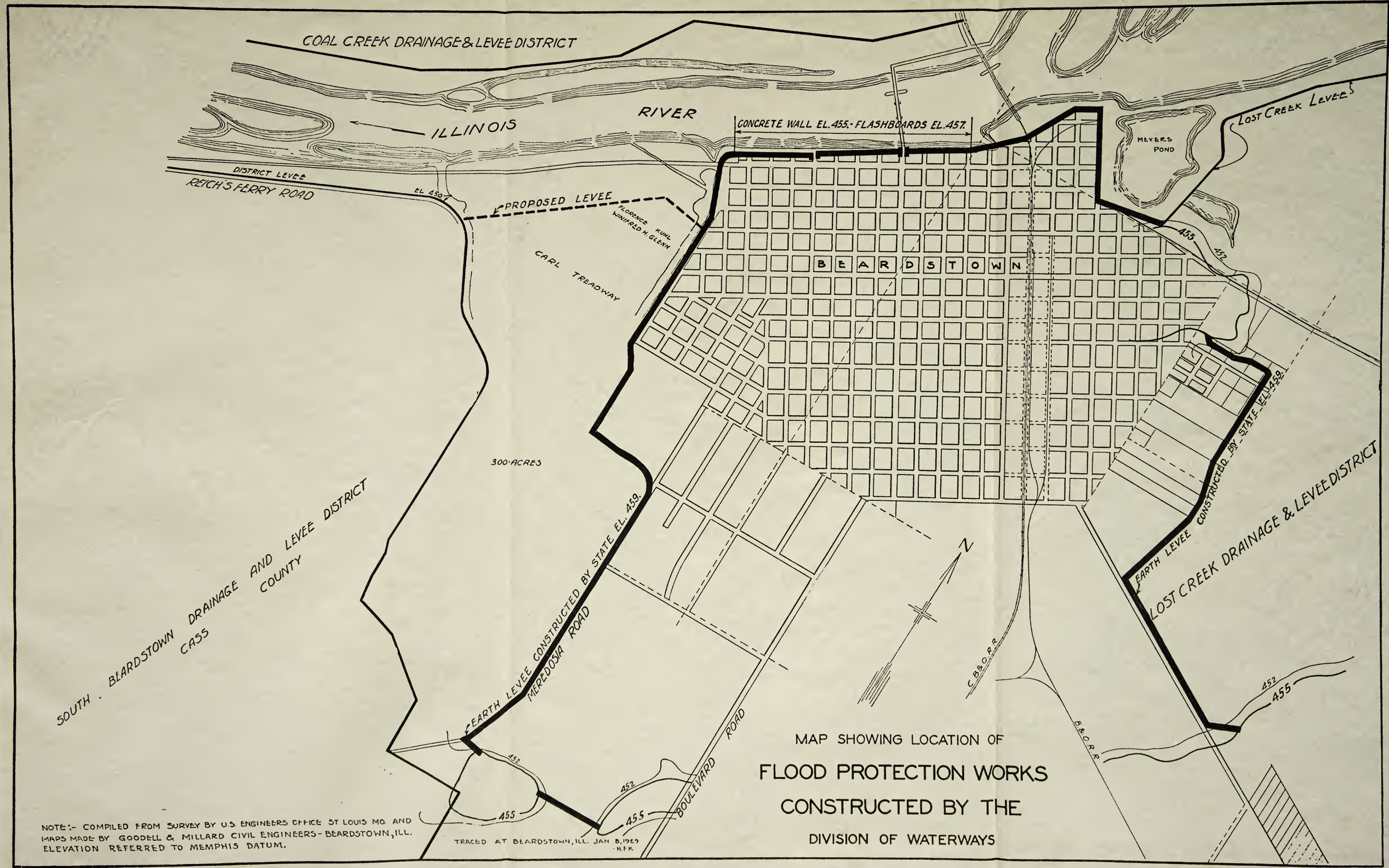
MAP SHOWING LOCATION O
FLOOD PROTECTION W
CONSTRUCTED BY T
DIVISION OF WATERWAYS


COAL CREEK DRAINAGE & LEVEE DISTRICT
ILLINOIS RIVER
CONCRETE WALL EL. 455.- FLASHBOARDS EL. 457.
MEYERS POND
LOST CREEK LEVEE
DISTRICT LEVEE
REICH'S FERRY ROAD
EL. 450
PROPOSED LEVEE
FLORENCE KUHL
WINIFRED H. GLENN
CARL TREADWAY
BEARDSTOWN
455
452
300-ACRES
SOUTH BEARDSTOWN DRAINAGE AND LEVEE DISTRICT
CASS COUNTY
EARTH LEVEE CONSTRUCTED BY STATE EL. 459.
MEREDOSIA ROAD
EARTH LEVEE CONSTRUCTED BY STATE EL. 459.
LOST CREEK DRAINAGE & LEVEE DISTRICT
N
C.B.&Q.R.R.
B.&O.R.R.
BOULEVARD ROAD
452
455
452
455
452
455
MAP SHOWING LOCATION OF
FLOOD PROTECTION WORKS
CONSTRUCTED BY THE
DIVISION OF WATERWAYS
NOTE:- COMPILED FROM SURVEY BY U.S. ENGINEERS OFFICE ST LOUIS MO. AND MAPS MADE BY GOODELL & MILLARD CIVIL ENGINEERS - BEARDSTOWN, ILL.
ELEVATION REFERRED TO MEMPHIS DATUM.
TRACED AT BEARDSTOWN, ILL. JAN 8, 1929
H.F.K.

STATE BUYS PUBLIC SERVICE COMPANY'S LAND.

Next in chronological importance, was the successful termination of negotiations with the Public Service Company of Northern Illinois, which owned substantially 1,877 acres of land on the DesPlaines River, extending from Brandon Road, which is about two miles below the city of Joliet, down to Dresden Heights, where the Kankakee River unites with the DesPlaines to form the Illinois River. The settlement agreement was signed September 15, 1927.

SECURES IMPORTANT LOCK SITE.

This land included the site of the State's lock and dam at Brandon Road, now under construction, as well as lands which will be submerged by the building of the proposed lock and dam at Dresden Island. It was formerly owned by the Economy Light & Power Company, which was for eight years involved in litigation with the State over the question of its right to construct a power dam in the DesPlaines River near the site of the proposed State dam at Dresden Island.

Appraisers for the Public Service Company had placed a value to the company of over $4,000,000 on this property and a sale value in excess of $2,000,000 to any purchaser not having the same facilities for distribution of electrical energy.

ALSO GETS 247 ACRES AT MARSEILLES.

The Marseilles Hydraulic Company, a subsidiary of the Public Service Company, also had a 99 year lease on 247 acres of land on the south side of the Illinois River at Marseilles which it was necessary for the State to acquire. The Public Service Company submitted a proposal to the State to sell the Brandon Road and Dresden Heights property and transfer the leasehold of the Marseilles property for $1,100,000. This offer was made because of the industrial and commercial benefits which will result from the completion of the waterway.

CONDEMNATION SUIT PROTECTED MINORS.

The price finally agreed upon was $975,000, but, owing to the fact that the rights of minor heirs of the original lessee of the Marseilles property were involved, a friendly condemnation suit was filed to determine the rights of all parties. The fee title to all the property was thus secured by the State for substantially the same price as originally agreed upon, plus the value of the residuary estate.

The total property acquired by this transaction amounted to 2,124 acres, and involved the examination of 48 separate abstracts of title. It opened the way for starting, in November, 1927, the Brandon Road Pool construction, the largest and most difficult part of the entire Illinois Waterway project.

STATE ITS OWN CONTRACTOR.

Probably the most interesting and certainly the most important and difficult task in connection with the entire Illinois Waterway project is presented by the Brandon Road Pool construction which includes not only the building of the lock and dam, two miles below the city of Joliet,

but also the construction of about four and one-half miles of concrete retaining walls, extending upstream from the dam. The river bed is of rock formation and there is a very rapid current. Because of the water hazards involved, the Division of Waterways has undertaken the construction of this project by the direct employment of labor, materials and equipment and is prosecuting the work with such success that it is probable the Dresden Island project will be handled in the same manner, as a means of expediting the completion of the waterway and at the same time reducing the total cost of construction.

In October, 1927, an arrangement was made with Green and Sons Company, Engineers and Contractors of Chicago, to act as superintendents of labor and construction of this work for the Division on a fee basis. The amount of the fee to be inversely proportional to the cost of construction. In other words, the lower the cost the greater the fee, thus putting a premium upon economy and efficiency.

GOVERNOR SMALL BREAKS GROUND FOR LOCKS.

"Chicago Commerce," official organ of the Chicago Association of Commerce, in its issue of November 26, 1927, prints the following report of an Illinois Waterway inspection trip participated in by representatives of the commercial and industrial interests of the State in conjunction with the actual breaking of ground for the Brandon Road Lock:

"WILL OPEN BARGE CANAL IN THREE YEARS.

"Governor Len Small officially started work on Brandon Lock, one of the last steps in completing the Lakes-to-Gulf Waterway, on the Illinois Waterway inspection trip made Friday, November 18, by members of the Chicago Association of Commerce, the Illinois Chamber of Commerce, the Mississippi Valley Association and the Illinois Manufacturers' Association. Officials making this trip expressed their belief that the waterway would be open to traffic in less than three years.

"William R. Dawes, President of The Chicago Association of Commerce, headed the delegation of more than seventy men which started from Chicago at 9 a. m. in a special Santa Fe train, meeting the Governor at Joliet at 10 a. m.

"The trip was favored by having a bright sun to offset the coolness and warm cars provided by the Santa Fe, Illinois Traction System and the Rock Island made it most comfortable. The snow which fell that day in Chicago had hardly touched the route which was followed. Excellent meals served by the Joliet Chamber of Commerce and on the Rock Island diner added to the pleasure of those making the trip.

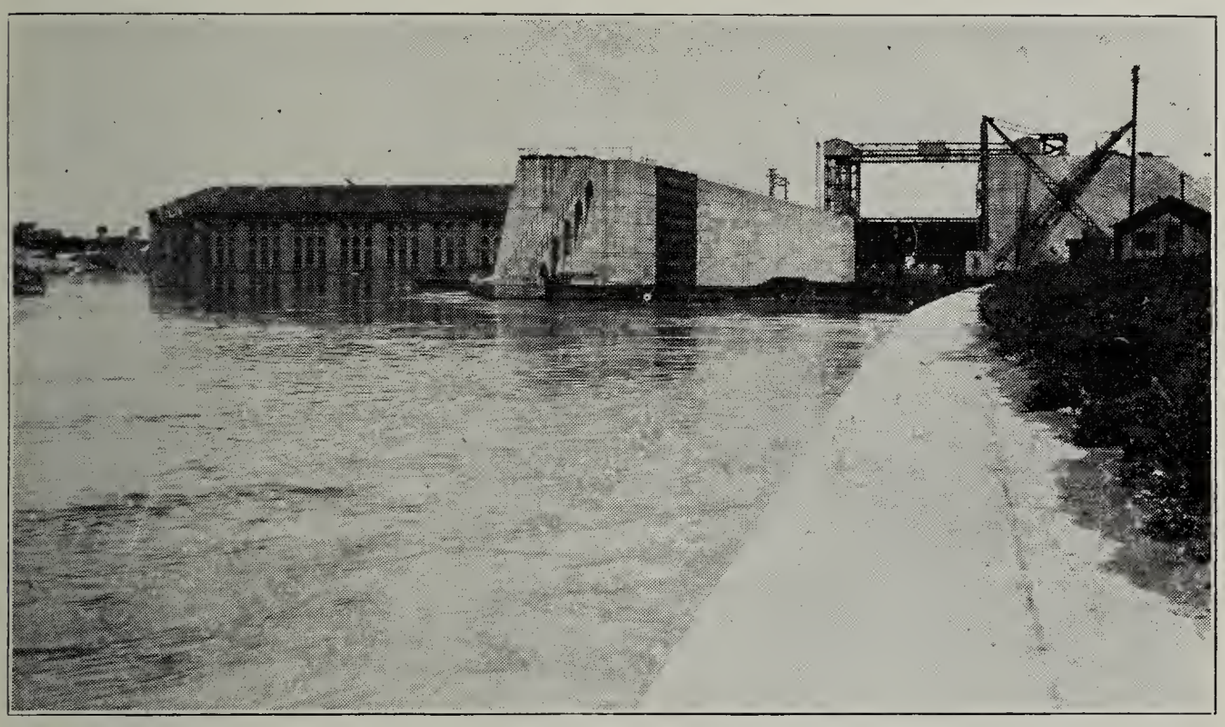
SUPERVISOR OF CONSTRUCTION TALKS.

"From Joliet the group, which numbered about seventy-five shippers and others interested in improved transportation, went back to the Lockport lock and power plant. A half hour was spent in inspecting this lock, William F. Mulvihill, Superintendent of the State Division of Waterways, explaining its operation and its part in the waterways plan. He said in part:

" 'The Illinois waterway consists of a series of locks and dams between Lockport and Utica, a distance of about 63 miles. This lock is located at the end of the main channel of the Chicago Sanitary District Canal about 35 miles from Lake Michigan. It is practically completed and is identical in horizontal dimensions with the other locks of the series, having a width of 110 feet and a usable length of 600 feet. It has a lift of 41 feet and is equipped at the upper end with two sets of gates of the lift type, weighing 200 tons each.

" 'The gates at the lower end of the lock are of the swinging type. Each gate being 55 feet wide and 63 feet high. They weigh 315 tons each. These gates, which are operated by electricity, are the highest lock gates in the world and when open fold back into the side of the lock. The lock can be filled and emptied in from 8 to 10 minutes and is large enough to permit locking through a fleet of barges carrying 9,000 tons of freight at a single lockage.'

"After inspecting this lock the party again boarded the train and returned to Joliet for luncheon at the Joliet Chamber of Commerce. At the station the Joliet High School band, twice champions of the United States, met them and preceded them in an impromptu parade to the local chamber building, the Governor thanking the band for its greeting in a short speech.



Lockport Lock of the Illinois Waterway, looking upstream.

In addition to the Chicago group more than 500 Joliet men and women attended the noon meal. Senator Richard J. Barr presided and introduced the speakers.

GOVERNOR SMALL SPEAKS.

"Thanking the people of Illinois for having made possible the waterways development, which has been sought since 1908, Governor Small said, following the luncheon:

" 'It is a great pleasure for me to meet this group of our visitors, business men from Chicago and other parts of the State of Illinois. Your deep and abiding interest in the early completion of the Illinois Waterway and in the opening of navigation from Lake Michigan to the Gulf of Mexico is demonstrated by this and former waterway inspection trips in which you have taken part.

" 'Permit me to thank you for your many kind words of appreciation of my efforts as Governor in pushing the waterway construction work to completion as rapidly as possible, so that the dreams of former generations may become the realities of the near future, to the mutual benefit of ourselves, and our neighbors of the Mississippi Valley.

" 'The people of Illinois in 1908, nineteen years ago, by overwhelming vote, authorized the issuance of $20,000,000 of waterway bonds to improve the DesPlaines and Illinois Rivers and to connect the Chicago Sanitary and Ship Canal at Lockport with the navigable waters of the Illinois River near Utica; but it was not until 1919 that the present Waterway Act was passed and although one contract was let just prior to my taking office, it is a

matter of fact that all of the actual work of construction has been accomplished under my administration. The early work was hampered and delayed by litigation and by negotiations over questions of water power and right-of-way. Fortunately, these troubles are now largely behind us.

" 'The inspection today of the practically completed Lockport job has made you acquainted with the size of the locks; all of which are of the same dimensions, except in the matter of their height or lift. Before the day is over, you will have visited the Marseilles Lock, which also is practically completed, and the Starved Rock job, which is about sixty-five per cent finished.

" 'This afternoon we start the work of excavation for the Brandon Road Lock, and I trust that within a very short time we shall be able to announce the beginning of work at Dresden Island, just below the juncture of the Kankakee and DesPlaines Rivers, which unite to form the Illinois, this being the site of the last lock and dam needed to carry the entire Illinois Water-

Excavating for side walls of Brandon Road Lock, near Joliet.

way project to completion. I assure you that I shall push this work with all possible vigor.'

"President Dawes speaking before the Governor, told the purpose of the day's trip. He complimented the Governor on the progress which has been made under the latter's administration and assured him of the heartiest cooperation in the work still to be done in giving Illinois a new outlet to the sea.

DOCKS ARE NEEDED.

"John H. Camlin, President of the Illinois Chamber of Commerce, stressed the necessity of cities along the waterway looking ahead and planning for the most effective use of the project when it is finished. He pointed out that, without dockage and efficient loading and unloading machinery, the expected saving in freight rates would not be made and the hoped for industrial development along the barge route would not take place.

"The promise was made by Congressman William E. Hull of Peoria, that the next session of Congress would appropriate the funds needed to complete the dredging of the Illinois River below the last lock at Starved Rock.

"Mayor Fred Sehring of Joliet expressed that city's approval of the waterways construction to date and assured the Governor of Joliet's co-operation in completing the task.

"After the luncheon, the party from Chicago boarded two special cars of the Illinois Traction System and proceeded to Brandon Road, two miles below Joliet. Here thousands of people had gathered to witness the turning of the first earth on the lock project there.

"Governor Small used a modern steam shovel rather than the old-fashioned spade for the ceremony, pulling the necessary levers amid the cheers of the large crowd. President Dawes, Mr. Mulvihill and Leslie Small also took part in this ceremony. A bit of humor was introduced into the scene when the Governor was paid by check for his labors.

"The site for this lock was recently acquired from the Public Service Company of Northern Illinois.

MULVIHILL TELLS ABOUT MARSEILLES LOCK.

"Due to shortness of time and almost impassable mud the lock near Marseilles, which is almost completed, was not visited. This lock and the one not yet started at Dresden Island, about fifteen miles down stream, were described by Mr. Mulvihill as follows:

" 'The fourth lock is about three miles below the city of Marseilles. It is completed except for the installation of machinery to operate the lock gates. It is expected that the dam already installed at Marseilles will be raised and a canal, constructed alongside the river, will connect the two.

" 'The third lock and dam will be at Dresden Island about 15 miles downstream from the Brandon Road Lock and just below the place where the Kankakee and DesPlaines Rivers unite to form the Illinois. The site for this was recently acquired from Wm. L. Wainwright and wife.'

"The fifth and last lock in the chain connecting the Great Lakes with the Mississippi system of rivers was the last one on the itinerary of the party. This lock and dam project is about 65 per cent completed. According to Mr. Mulvihill the five locks will provide a combined lift of 126 feet, which, allowing for a 14-foot slope downstream, will equal the 140-foot fall between the Sanitary District Canal and Starved Rock.

"After inspecting this lock, the party returned to Ottawa by Illinois Traction. Dinner was served on the Rock Island train which carried the group from that city back to Chicago.

PERSONNEL OF PARTY.

"Included in the group making the trip were the following men from Chicago and other parts of the State:

"Governor Len Small, Springfield, Ill.; William F. Mulvihill, Supt. Division of Waterways, State of Illinois, Chicago; William R. Dawes, President The Chicago Association of Commerce; Anderson, S. T., Alward-Anderson-Southard Co., Chicago; Andrews, O. F., Special Representative, Chicago Association of Commerce; Appel, J. H., President Illinois Bankers Association, Highland Park, Ill.; Barr, Richard J., Joliet, Ill. (Waterways Committee, Illinois Chamber of Commerce); Baum, H. A., Safety Electric Company, Chicago; Blocker, A. L., Secretary, South Chicago Chamber of Commerce; Burke, Frank, Waukegan, Ill., Illinois Chamber of Commerce; Camlin, John H., President, Illinois Chamber of Commerce, Rockford; Colburn, D. S., Marquette Cement Mfg. Co., Chicago; Cook, LeRoy, Real Estate, Chicago; Cunningham, J. D., President, Republic Flow Meters Co., Chicago; Dumond, L. A., Manager, Industrial Department, The Chicago Association of Commerce; Ferris, C. G., General Secretary, Illinois Chamber of Commerce; Gardner, H. C., Gardner & Lindberg, Engrs. (Chairman, Harbors and Waterways Committee, The Chicago Association of Commerce); Haenisch, Herman, Consumers Company, Chicago; Harris, E. T., Payson Mfg. Co. (Chairman Waterways Committee, Illinois Manufacturers' Association).

"Haynes, J. P., Traffic Director, Chicago Association of Commerce; Hess, Franklin, Gen. Atty., International Harvester Company, Chicago; Hooker, John P., President, Chicago Real Estate Board; Hudson, J. H., Secretary,

Retail Interest Department, Illinois Chamber of Commerce; Hull, Wm. E., Peoria, Ill.; Judd, C. W., Acting Business Manager, The Chicago Association of Commerce; Lyford, H. B., Vice Pres., Hibbard Spencer Bartlett & Co.; McLeay, Lachlan, Secretary, Mississippi Valley Association, Chicago; Marsh A. Fletcher, Marsh & Truman Lumber, Chicago; Miller, H. F., Manager, Interstate and Foreign Commerce Committee, Chicago Association of Commerce; Moisant, S. E., Kankakee, Ill., Illinois Chamber of Commerce; Newspaper Representatives of: Associated Press, Chicago American, Chicago Daily Journal, Chicago Daily News, Chicago Herald-Examiner, Chicago Journal of Commerce, International News, Chicago Evening Post, Chicago Tribune, United Press; Pirie, John T., Carson, Pirie, Scott & Co. (Chairman, Transportation Committee, The Chicago Association of Commerce); Putnam, Maj. Rufus W., Chief Engineer, The Harbor Plan of Chicago; Sankey, John E., Joliet Gravel Co., Joliet, Ill.; Schlake, William, President, Illinois Brick Company, Chicago.

"Smith, Sidney A., Currier-Lee Warehouse Co.; Stephens, George, Editor, Illinois Journal of Commerce, Chicago; Taylor, Eugene S., Manager, Chicago Plan Commission; Thorp, H. W., President, Goodrich Transit Co., Chicago; Wait, Clarence A., Decatur, Ill., Illinois Chamber of Commerce; Williams, Walter, Benton, Ill., (Chairman Waterway Committee, Illinois Chamber of Commerce); Pirie, John F., Jr., Carson, Pirie, Scott & Co.; Charlette, Geo. B., Carson, Pirie, Scott & Co.; Thain, R. J., Carson, Pirie, Scott & Co.; Graham, C. E., A. T. & S. F.; Minchin, G. H., A. T. & S. F. R. R.; Moriarty, J. R., A. T. & S. F. R. R.; Pixley, H. D., Carson, Pirie, Scott & Co.; Stadill, C. W., Carson, Pirie, Scott & Co.; Livingston, Charles A., the Illinois Manufacturers' Association; Westman, Edw. C., the Illinois Manufacturers' Association; Brent, Theodore, New Orleans; Lynde, Cornelius, Chairman, Miscellaneous Solicitations Committee; Eberhard, Fred U.; Cornish, L. D., Asst. Chief Engineer, State Division of Waterways; Miller, J. N., Illinois Rivers Division of Mississippi Valley Association; Webster, James, New York Central lines; Jacobson, R. A., Rock Island Plow Co.; Luth, L. E., Association of Commerce, Winona, Minn.; Mueller, Herman, St. Paul Association."

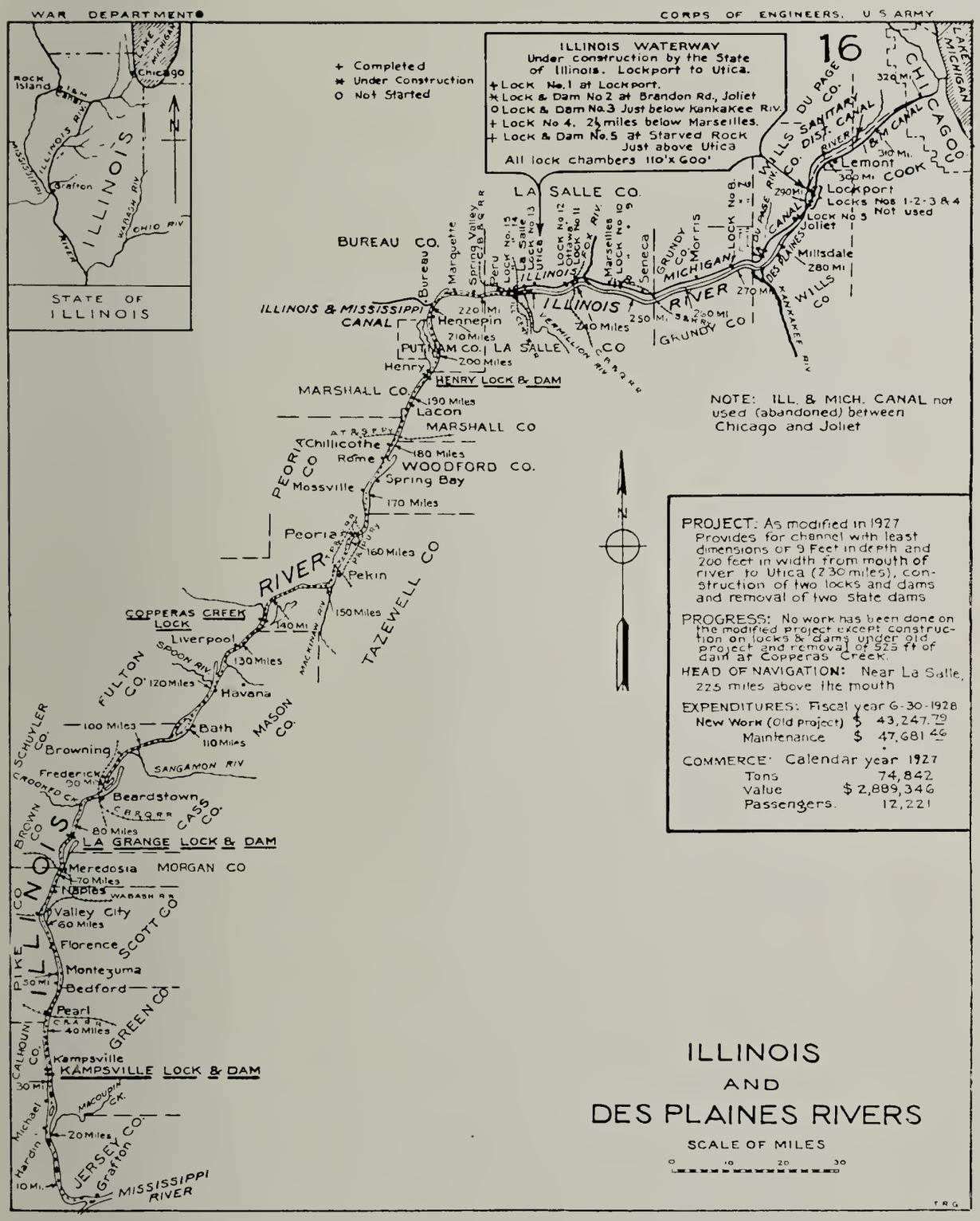
In addition to the foregoing literally thousands of people assembled at Brandon Road Lock site to witness the ceremony of breaking ground for this most important project of the Lakes-to-the-Gulf Waterway.

IMPROVEMENT OF LOWER ILLINOIS RIVER.

In accordance with the Act of Congress of January 21, 1927, the Federal government modified the project depth of the Illinois River so as to increase the depth of channel from 7 to 9 feet with a minimum width of 200 feet from the mouth of the river at Grafton to connect with the Illinois Waterway at Utica, a distance of about 225 miles. This Act also provided for transfer by the State of Illinois to the Federal government of the two State-owned locks and dams in the Illinois River and the removal by the Federal government of said dams. In compliance with this Act of Congress and under authority of an Act of the General Assembly of the State of Illinois approved June 21, 1919, entitled, "An Act authorizing the dams, works and appurtenances at Henry and Copperas Creek to be granted to the United States," the Department of Purchases and Construction formally conveyed to the Federal government the dams, works and appurtenances referred to, possession being surrendered at the end of the fiscal year.

STATE-OWNED DAMS TO BE REMOVED.

The locks and dams in the Illinois River at Henry and Copperas Creek were constructed by the State of Illinois in 1871 and 1877, respectively. The locks are 73 feet wide and 325 feet usable length, the Henry dam being 541 feet long and the Copperas Creek dam 640 feet



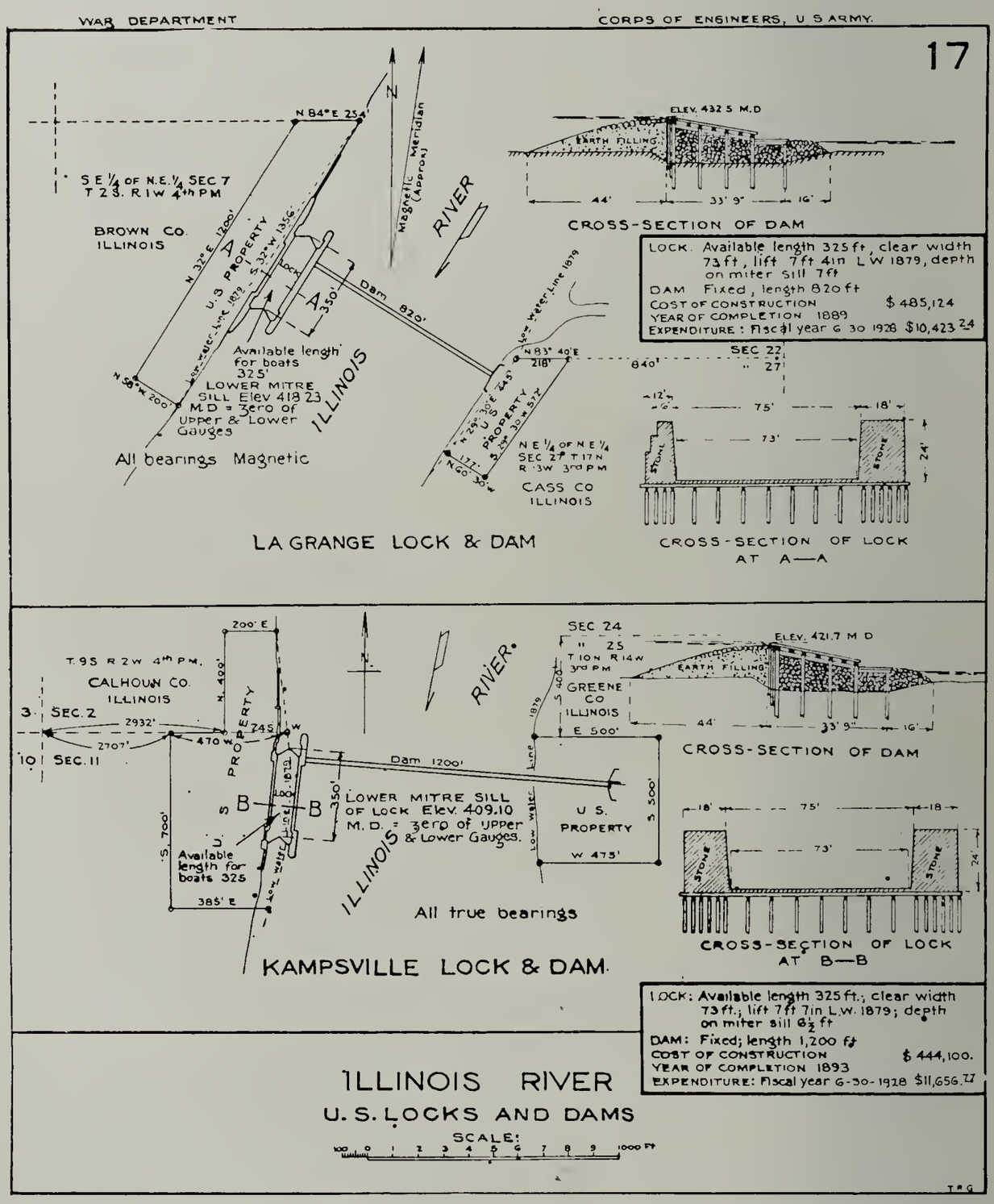
The connecting link for navigation between Lake Michigan and the Mississippi River.

in length. Both of these dams are to be removed in the interest of navigation.

Two other dams in the lower Illinois, one located at LaGrange, 820 feet long, 80 miles from the Mississippi, and the other at Kampsville,

1,200 feet long, 30 miles from the mouth of the Illinois, were completed in 1889 and 1893, respectively. The locks are the same dimensions as at Henry and Copperas Creek.

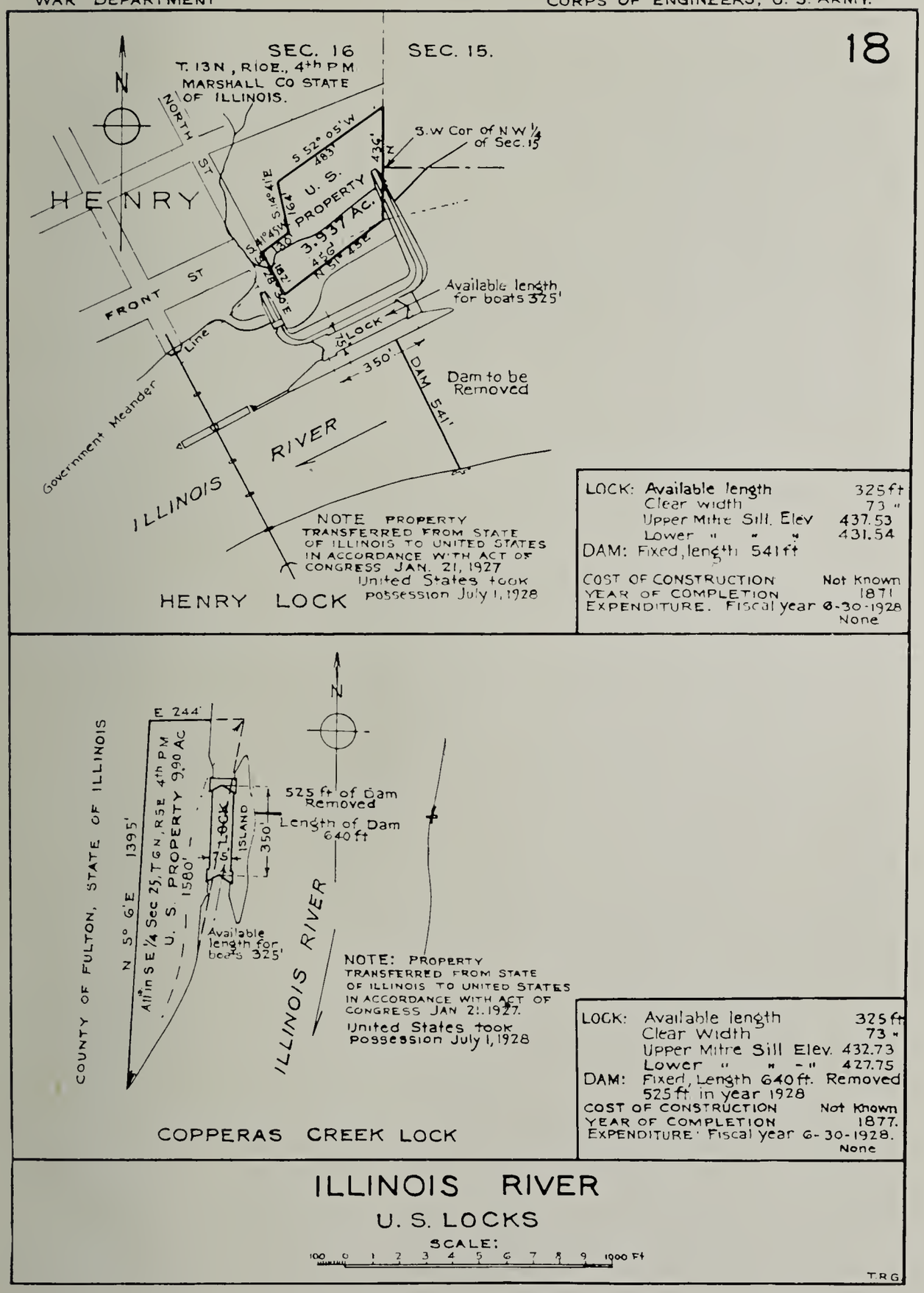
As all the lock chambers of the Illinois Waterway are 110 feet wide by 600 feet usable length it is hoped that the Federal government will



These Federal Locks and Dams in the Illinois River, are to be retained for the present but may be removed or changed later.

not only remove the Henry and Copperas Creek dams but will also remove or modify the LaGrange and Kampsville dams so as to provide open river navigation from the end of the Illinois Waterway to the Mississippi River, a distance of 225 miles, with a total fall of only 28 feet or about one inch to the mile.

WAR DEPARTMENT CORPS OF ENGINEERS, U. S. ARMY.



These Locks and Dams were turned over to the United States by the State. The Dams have been or will soon be removed.

FLOOD CONTROL A NATIONAL PROBLEM.

GOV. LEN SMALL IN WASHINGTON URGES FEDERAL ACTION.

On November 7, 1927, Governor Len Small, accompanied by the Director of the Department of Purchases and Construction, the Supervisor of Illinois Waterway Construction, and by other public officials of the State and representatives of important industries and interests affected by flood conditions in the valleys of the Illinois and Mississippi Rivers, appeared in his official capacity before the Flood Control Committee of the House of Representatives of the United States, at the National Capitol in Washington, for the purpose of urging that an adequate flood protection program for the Mississippi River and its tributaries be provided by the Federal government.

In addressing the Flood Control Committee Governor Small, among other things, said:

"The people of the State of Illinois feel that flood conditions in our State, and in the Mississippi Valley below us, this last year, were of such wide scope and devastating nature as to call for immediate action by Congress looking to the prevention of any recurrence of similar disasters in the future. This, we feel, can be assured only by a broad system of flood control, satisfactory alike to the Federal government, the states and the people of the flood areas.

"The people of Illinois, whom I have the honor to represent as Governor, respectfully petition your committee, and through you the Congress of the United States, for the prompt preparation and enactment of laws adequate for the permanent protection of their homes and property against the recurring menace of flood waters which create conditions beyond the control of the State or of the communities affected.

FLOOD CONTROL PROBLEM IS NOT NEW.

"The problem of flood control is not new. From time to time for the past 50 years, at least, it has been the subject of discussion in the halls of Congress and for about 40 years the Mississippi River Commission, as an agency of the Federal Government, has been dealing with this problem in the Mississippi Valley. But the fact that no adequate solution of the problem has yet been provided is established by the devastating calamity of the present year, which again makes this subject of such major importance as to demand immediate consideration and early action by the Congress of the United States.

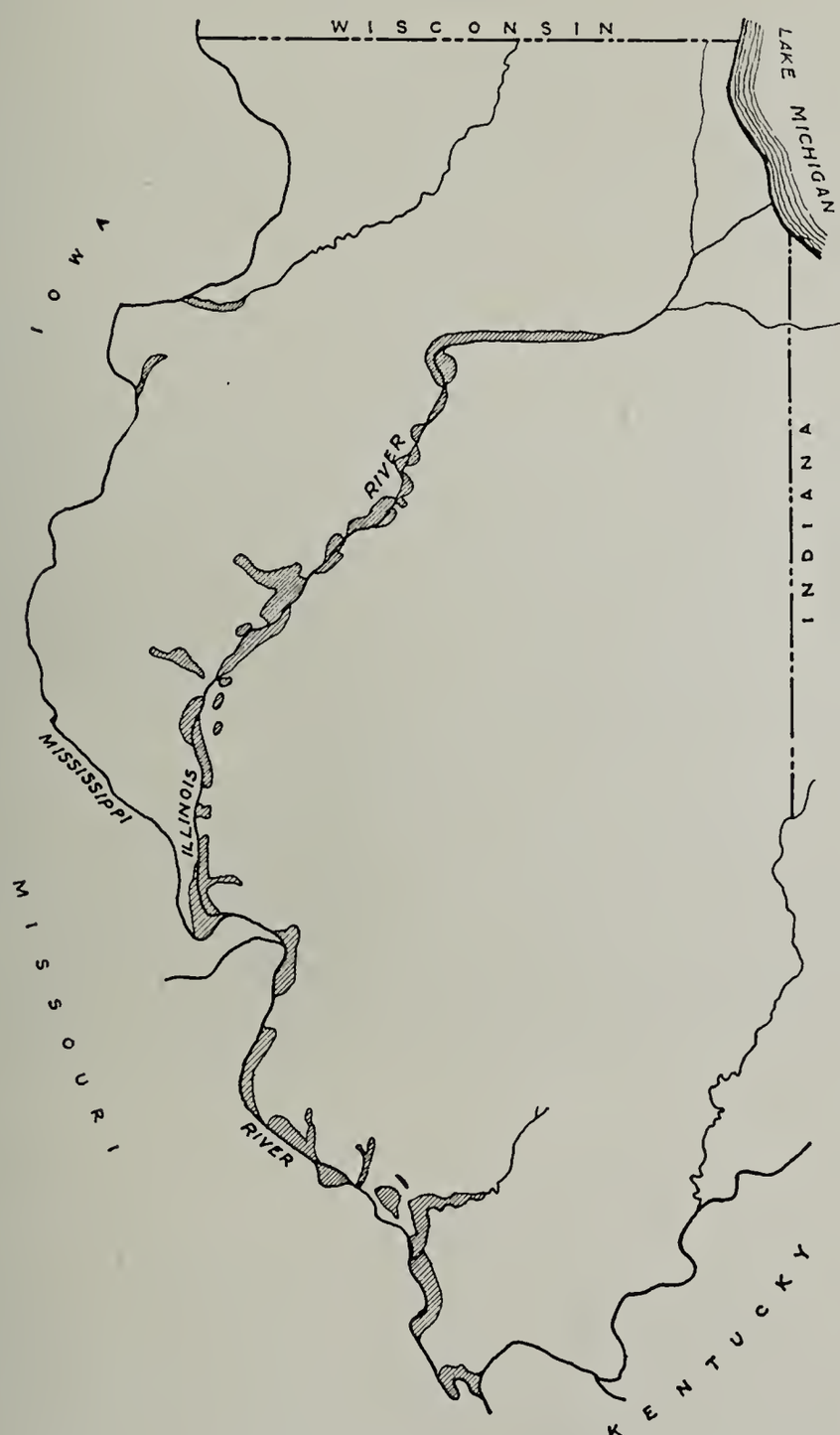
"Under these circumstances, I congratulate the members of this committee upon their opportunity to perform a constructive public service and I also congratulate the people of the United States, and particularly the residents of the stricken areas, upon the deep and intelligent interest you have shown. We thank you, gentlemen, for the timely and careful consideration being given by you to this most important subject, and sincerely trust that such facts and figures may be presented, and such methods and meaures may be prepared, as will permit prompt and intelligent action to be taken by the Congress which will meet next month.

ILLINOIS IS IN MISSISSIPPI FLOOD AREA.

"The Mississippi drainage area equals 40 per cent of the territory of continental United States, and the waters of nearly one-half the States find their way to the sea through the valley of the Father of Waters.

"The State of Illinois is river-washed. It is largely bounded on the east and south by the Wabash and Ohio Rivers, and on the west by the mighty Mississippi. It is diagonally bisected by the DesPlaines and Illinois, which within the next three years—when present projected improvements are completed—will provide the connecting link in the Lakes-to-

the-Gulf-Deep-Waterway. These boundary and bisecting rivers, are all sizable streams—navigable waters of the United States—and tributaries of the Mississippi. The flood conditions of the Mississippi Valley are of great importance to the people of the State of Illinois.



Where the Illinois and Mississippi Rivers overflow onto thousands of the most fertile acres in the world. The shaded portions are the areas which were submerged during the floods of 1922, 1926 and 1927. Detailed reports show that total losses in excess of $30,000,000 were inflicted during the six-year period covered by these flood times. Thousands were driven from their homes, merchandise was ruined and hundreds of thousands of acres of farm lands were covered with water for months at a time.

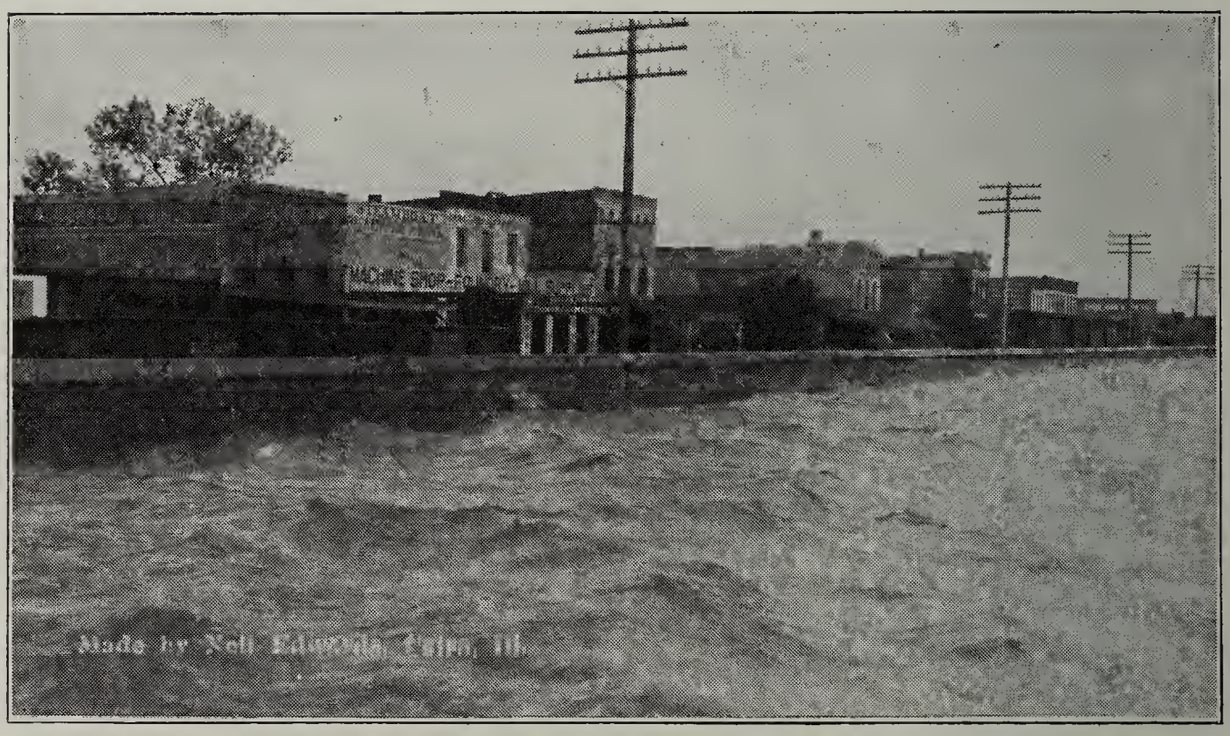
"At the present time the jurisdiction of the National government, in the matter of flood control, is represented by the Mississippi River Commission, and is limited to the Mississippi River itself, between Rock Island in the State of Illinois and the Gulf of Mexico, with jurisdiction over the tributary streams only so far as such tributaries are affected by flood conditions of the Mississippi.

FLOOD CONTROL A NATIONAL PROBLEM.

"It is my deliberate conviction that the problem of flood control is a national problem for the following reasons:

"First, because the flood areas are too large, the flood damage too great and the flood sources are too remote for effective local, or even State-wide, administration and control. No one State can successfully deal with this problem, even the protection of its own territory and people.

"In the second place, flood control by the Federal government is not only justified, by reason of the extent of the territory affected, but in my opinion, this problem is a proper subject for governmental attention because of the established economic fact that any preventable calamity, which injuriously affects the welfare and prosperity of the people of any considerable portion of the country cannot fail to have a detrimental effect upon the rest of the



Concrete Wall, Cairo, Ill., built by State in 1914, flood of April, 1927, near crest.

country. That which harms a part of the people is a matter of profound concern to all the people, especially where the calamitous conditions are incapable of control by the local community.

"Third, the Mississippi Valley contains the most fertile soil and is perhaps the most productive area in the entire United States. The lands lying in the flooded districts constitute "the bread basket and the sugar bowl" of America. The appropriations necessary to preserve the productivity of this great region, and to protect the people and property, both private and public, from future flood disaster will, in my opinion, prove to be a wise and desirable expenditure of public funds, resulting in great advantage to all the people and the government of the United States.

EXPENDITURES WILL PAY DIVIDENDS.

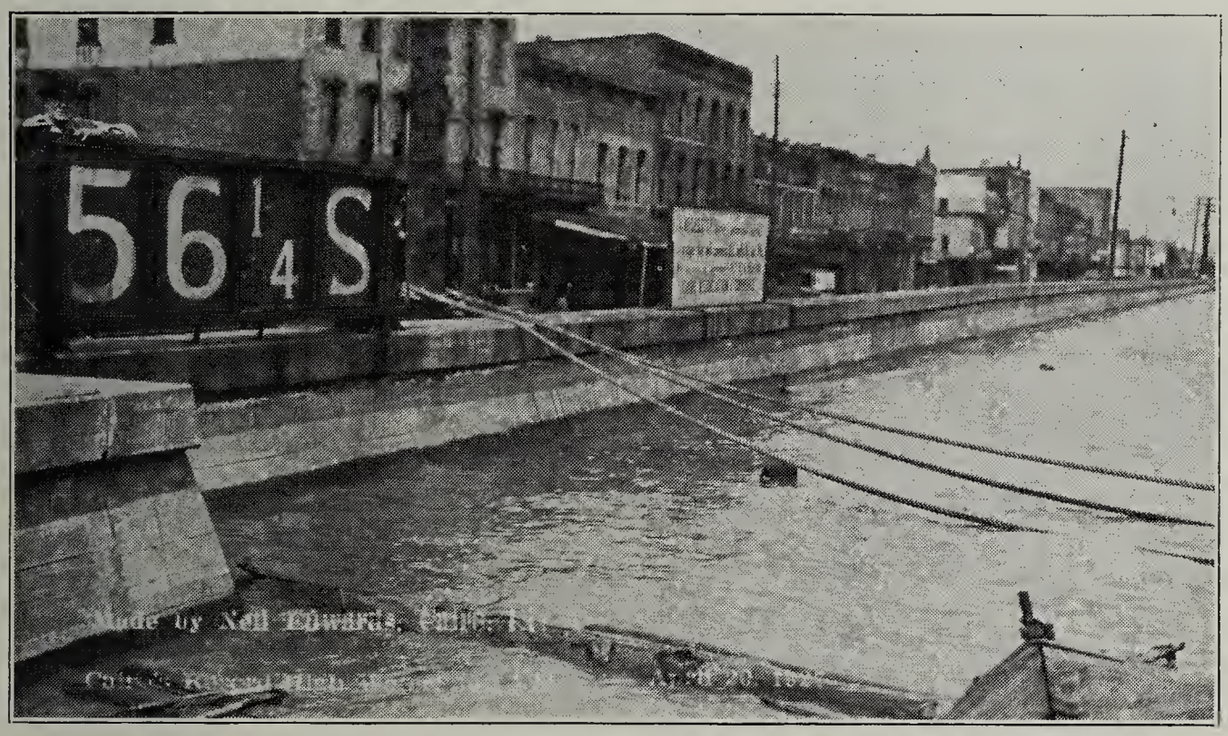
"The policy of river and harbor development by the National government has proved to be of benefit to all the people, and not merely of benefit to the residents of places where a particular local improvement has been financed by the Federal government. Great as the nation's expenditures for river and harbor improvement have been, I am advised that the public benefits derived therefrom are equal to a return of 100 per cent per annum on the investment. In other words, I am told that the entire costs of river and harbor improvement, since the beginning of the government, are equalled, every year, by the reduced costs of transportation and other public benefits

resulting therefrom. I prophesy, that, in like degree, the National appropriations necessary to provide proper flood protection for the Mississippi River and its tributaries, will be returned to the people of the entire country, every year, in reduced cost of living, due to the assured productivity of the vast territory which now seeks protection at your hands.

DETAILED REPORT PRESENTED.

"The flood troubles of the State of Illinois occur chiefly in the valleys of the Illinois and Mississippi and are due to the heavy rainfall upon the head-waters of the streams, with consequent overflow damage on the Illinois River from Peoria to Grafton and on the Mississippi from East St. Louis to Cairo.

"I shall ask permission to insert in the record, a statement, prepared at my direction by the Division of Waterways of the State of Illinois, Mr. Wm. F. Mulvihill, Supervisor, giving in detail the information concerning flood



U. S. Government Gauge Marker, Cairo, Ill., at crest of flood, April, 1927.

conditions in Illinois, which was requested by the chairman of your committee.

"This report deals chiefly with the floods causing excessive property damage on the Illinois and Mississippi Rivers and their tributaries in the Spring of 1922—the Fall of 1926 and the Spring floods of this year.

"While the volume of flood water in 1926 in Illinois was not greatly in excess of previous records it appears that the extensive construction of levees for reclamation of lands in the natural overflow areas, caused unusual flood heights, by reducing the flood flow section of the river.

"The effect of levee construction and channel contraction is also shown in added flood heights of the Mississippi River, especially on the Cairo gauge. In this connection I desire to call especial attention to the fact that a short distance below Cairo the discharge capacity of the Mississippi River is inadequate causing the flood waters to back up—thus increasing the high water stages at Cairo and placing that city in a very precarious position.

ILLINOIS FLOOD LOSSES $30,000,000 IN SIX YEARS.

"Aside from the cities of Beardstown and Cairo, the war with the flood waters of 1927 was not as spectacular in Illinois as in the vast area below the mouth of the Ohio, and it may therefore be somewhat of a surprise to

some members of your committee to learn that in the State of Illinois over 220,000 acres of the most productive reclaimed agricultural lands of the United States were completely submerged, and 200,000 additional acres of the natural flood plane were also inundated.

"There is submitted herewith a detailed tabulation of reports from engineers and officials of drainage and levee districts and municipal officers of Illinois showing estimated flood losses and consequential damage amounting to over $30,000,000 in the past six years.

"As Governor of the State of Illinois for the past seven years, during which period our people have gone through these trying experiences and have suffered these tremendous losses, there has been impressed upon my mind the menace of the uncontrolled flood waters, and the imperative necessity for the establishment of a broad system of National flood control, through which alone, it seems to me, the recurrence of similar disasters in the future can be prevented.

Concrete wall, Cairo, Ill., with 1927 flood several feet above railroad tracks at right.

STATE PROVIDES EMERGENCY RELIEF.

"The hardships so patiently borne by flood sufferers of Illinois, their fortitude under misfortune and their financial inability adequately to protect themselves and their property from the ravages of the rivers have impelled me, from time to time, in official messages to urge upon the legislative department of our State government the making of appropriations from the public treasury, for emergency relief of the submerged areas and for the development of plans, in conjunction with the Federal government, for permanent flood prevention through a scientific and comprehensive plan for flood control.

"Acting upon my suggestion and, in accordance with the request contained in a special message to the members of the Fifty-fifth General Assembly, representating the people of the State of Illinois, the legislature, on June 15, 1927, by joint resolutions, adopted a "memorial and petition, addressed to the President and Congress of the United States, suggesting the enlargement and extension of the powers and duties of the Mississippi River Commission to include the territory drained by the Illinois River and other tributaries of the Mississippi in the matter of flood control and protection.

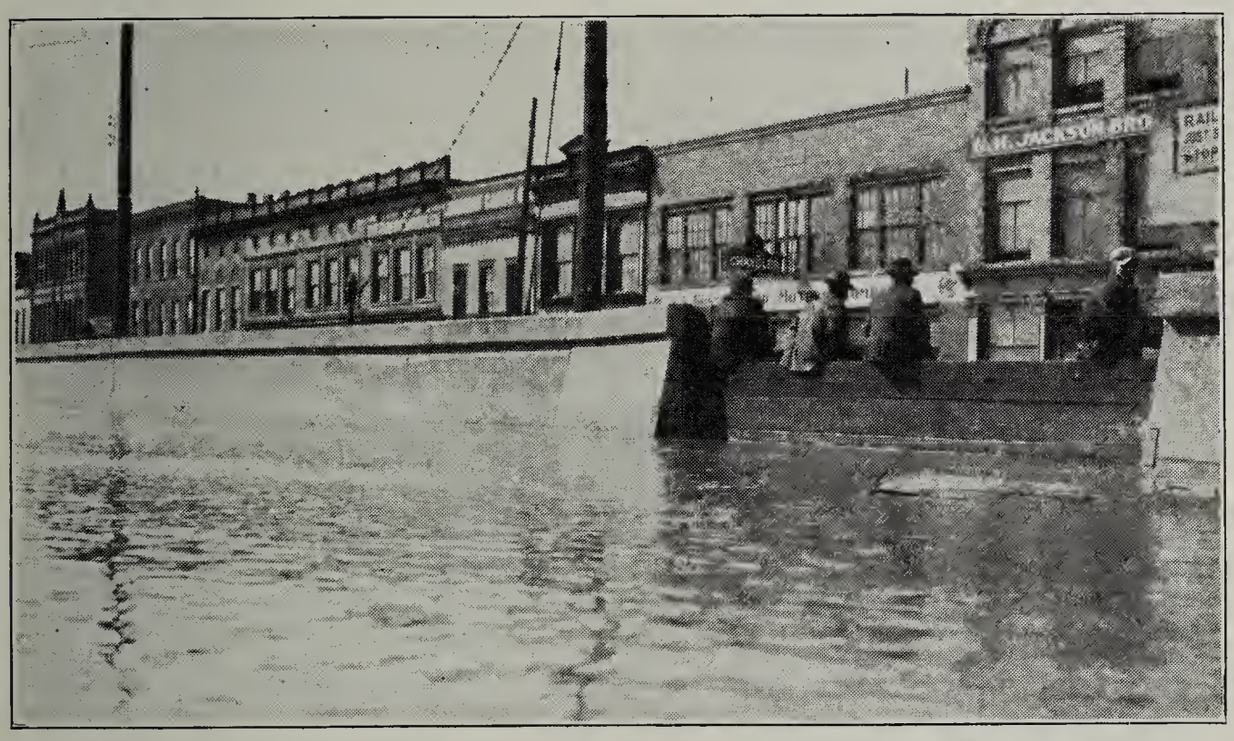
"I further suggested to the General Assembly that 'While this is a problem of National scope, which must find its solution in a National program, yet as an evidence of the interest and good faith of our State, an adequate special appropriation should be made to the Department of Purchases and Construction, Division of Waterways, to provide for an engineering study of the flood situation throughout Illinois, and for use in conjunction with other states and the Federal government in the development of a comprehensive plan for the relief and protection of the people of our State, in harmony with the recommendation contained in my biennial message of January 5, 1927.'

"An appropriation of $50,000 for this purpose was accordingly made and is now available.

APPROPRIATES $1,500,000 FOR TEMPORARY AID.

"The General Assembly also appropriated from the State treasury the sum of $1,500,000 'to furnish emergency relief in the areas in Illinois which have been inundated or damaged by floods and for the temporary construction, repair or reinforcement of levees in such districts.'

"That the sentiment of the people of Illinois is in favor of permanent flood control and of immediate flood relief, is indicated by the fact that the



Concrete wall, Cairo, Ill., showing timber bulkheads used at street openings.

General Assembly appropriated the sum of $1,500,000 for emergency flood work by an almost unanimous vote. It is further evidenced by the fact that the people of the city of Chicago voluntarily contributed more than $1,000,000 additional for flood relief purposes.

"Another appropriation of $350,000 was made for the construction of concrete walls along the Illinois River at Beardstown and for earth levees connecting the same with the high ground back of the city, thus providing, it is hoped, some measure of permanent protection for the people of this long-suffering community.

"Thus it will be seen that the legislature of the State has this year provided nearly $2,000,000 for flood relief work in the State of Illinois. These appropriation bills became effective on July 1st, since which time the Division of Waterways has negotiated nearly seventy contracts for the repair of flood damages (including the Beardstown river wall and levee construction), aggregating considerably more than $1,000,000, which contracts provide for

completion of the work before January 1, 1928. The balance of the work will be contracted as rapidly as possible.

STATE WILL COOPERATE IN NATIONAL PLAN.

"It is said that faith without works is dead. But the State of Illinois has shown her faith by her works, and is only asking from the Federal government at this time the same thing that she herself has undertaken to do, in a limited way, for the people within her own borders, namely: To provide such immediate repair of broken levees and emergency relief, as will permit the people in the flooded areas some measure of protection against ordinary high water and thus the possibility of producing a crop on their lands in 1928, while, at the same time, making provision for careful study and an adequate program for permanent flood protection."

TEXT OF FLOOD REPORT PRESENTED.

The detailed report concerning flood conditions in Illinois, which was inserted in the record of the proceedings of the Flood Control Committee, follows:

INFORMATION CONCERNING FLOOD CONTROL REQUESTED BY CHAIRMAN OF THE FLOOD CONTROL COMMITTEE OF THE HOUSE OF REPRESENTATIVES.

Compiled by the Division of Waterways and Presented by the Governor of Illinois.

Date of Floods:

Floods causing excessive property damage occurred on the Illinois and Mississippi Rivers and their tributaries in Illinois in 1922, 1926 and 1927.

Extent of Floods:

The extent of floods causing damage were as follows: Illinois River from Peoria to Grafton, Sangamon River from Springfield to its mouth, Mississippi River from East St. Louis to Cairo.

How Long Did the Floods Last:

		Mississippi River.	
Sangamon River.	Illinois River.	E. St. Louis.	Cairo.
1922..... 48 days	1922..... 62 days	1922.....14 days	53 days
1926..... 42 days	1926..... 66 days	1926..... 0 days	0 days
1927.....109 days	1927.....151 days	1927.....33 days	75 days

Depth of Water on Flooded Lands:

The depth of water on Drainage and Levee Districts in some cases was as great as 15 feet. In the city of Beardstown on the Illinois River, 80 per cent of the city was submerged up to a maximum of about 12 feet.

Compare High Water with Former Floods:

The 1922 flood on the Illinois River was the highest on record since 1844 from LaSalle to Grafton and exceeded all previous records from Havana to Valley City but new records between these latter places were again established by the 1926 flood. The 1927 flood was approximately the same in flood heights as was the 1922 flood. Mississippi River floods were as follows:

	1844.	1903.	1913.	1922.	1926.	1927.
At St. Louis.....	41.39	38.00	27.2	33.95	29.4	36.1
At Cairo	46.8	50.57	54.69	53.6	40.8	56.4

Cause of Floods:

The cause of these floods was excessive rainfall upon the head-waters of the streams concerned, which, in the case of the Illinois River, was unusually excessive for such a small area. The volume of floods according to government records was not greatly in excess of previous floods but the construction of levees for the reclamation of overflowed areas had greatly re-

duced the flood flow section of the rivers and thus produced unusual flood heights for the volume of discharge of this river. The effect of levees and channel control work also affected the flood heights on the Mississippi River from East St. Louis to Cairo but to a considerable lesser degree than on the Illinois.

Names of Places Where Levees Broke:

The names of places where levees broke are shown on the map of Illinois attached hereto and are also listed on the attached tabulation of damages to districts and cities.

Names of Rivers Overflowing:

As given above and shown on map attached.

Character of Territory Flooded:

The principal territory flooded consisted of farm lands which had been reclaimed by levees. These reclaimed farm lands were unusually productive especially for grain. When the Drainage and Levee Districts are new, the

Bulkheading and sandbagging along Mississippi River Levee of the Cairo Drainage District flood of 1927.

yield is confined almost entirely to corn, the production being from 80 to 100 bushels per acre. In the course of ten years, the yield is reduced to about 60 bushels of corn per acre. The yield of wheat, runs from 30 to 40 bushels per acre.

Names of Towns and Cities Flooded:

East Peoria, Naples, Beardstown and Mounds were the places which suffered the most damage from floods. Others wholly or partly under water were Liverpool, Browning, Frederick, Meredosia and Valley City.

General Information Relative to Places Flooded:

The population of flooded areas in Illinois was almost entirely white except in the vicinity of Cairo, Illinois. In Beardstown the workers residing in the suburbs only were compelled to leave their homes; but at Mounds, Illinois, more than one-half of the entire population were compelled to leave the city for about four weeks in 1927. Those who were forced to evacuate their homes were taken care of in other houses and in tents on higher ground. There was no loss of life in Illinois and but few of the people were injured, none

of them seriously. There was no reported increase of sickness which could be attributed to the result of the floods except at Mounds, where a severe outbreak of typhoid occurred due to flood waters carrying contents of cesspools throughout the city.

In the cities of Beardstown and Mounds, the effect of the floods on the morale of the people was a very marked demonstration of the pioneer fighting spirit of the American people as they turned on *en masse* and fought the floods with undiminished vigor so long as there was any possibility of protecting their community and until the waters receded the people showed a marked feeling of cheerfulness in the face of troubles which they were all experiencing. Although the city of Beardstown was under water for several weeks in the Fall of 1926 and the Spring of 1927, business was not suspended, the people going to and from their places of business in row boats or hip rubber boots. An excellent report of the Illinois River flood of 1922 was made by H. Merrill Wills, Meteorologist of Springfield, Illinois. The conditions shown by this report are also typical of the 1926 and 1927 floods. Excerpts from this report are attached.

Mississippi-River Levee at 33rd street, Cairo, Ill., showing large quantity of sand bags used at this point during flood of 1927 to prevent sloughing of inside slopes. This levee has been repaired under provisions of the State Flood Relief Act of 1927.

Loss and Damage Statistics:

These are shown in detail in the tabulation of reports received from various sources attached hereto. However, a summary of these tabulations follow:

Flooded areas, Drainage and Levee Districts	$25,648,517.00
Cities flooded	3,267,500.00
Railroads	1,071,668.00
State highways	750,000.00
These items combined aggregate	$30,737,685.00

The volume and activity of business in the flooded towns and cities of Illinois is closely related to the prosperity of the agricultural districts which they serve, and except as specifically noted in the attached reports from cities, the effect of the floods on industry was similar to the effect upon agriculture. Along the Illinois and Mississippi River Valleys about 225,000 acres of land was under water from two months to two years, due to the

inability of the Drainage and Levee Districts to repair their levees and remove the water by pumps and natural drainage.

Effect of Floods on Railroads:

Five of the railroads operating in the flood areas report damage and losses totaling $1,071,668.00, a total of 122.4 miles of track washed out and thirty-two bridges severely damaged or destroyed. Many of the other roads operating in these areas report that while they experienced no direct loss or appreciable delays, they were nevertheless subject to an indirect loss due to depressed business conditions in the areas affected and also the fact that when business is once lost by suspension of service embargoes, etc., it requires from six to twelve months to regain the confidence of the shippers. This indirect loss cannot be estimated but is said to be enormous.

Effects on Highways:

The Division of Highways reports that the damage to State roads amounts to $750,000.00. This does not cover the damage that has been done to innumerable gravel roads maintained by the various counties, towns, etc., in the flooded areas.

Excerpts from a report of the Illinois Bankers' Association dated November 3, 1927, are as follows:

Cross Levee at Cairo, Illinois, April 27 1927, on new Levee street, showing view inside levee heavily sandbagged to check seepage and nest of sand boils around outbuilding with treatment used during their operation.

Effect on Banks and Bank Clearings:

The direct financial loss in actual deposits and potential deposits will aggregate many millions of dollars and will probably require from five to ten years to replace. The loss in clearings is in direct proportion to the deposit loss and the effect in large centers away from the immediate flood district will approximate 5 per cent both in deposits and clearings. In the case of a general calamity, such as these floods have produced, that result applies to every financial institution in localities affected and goes back through the correspondent banks to the reserve centers. In the ridge districts from fifteen to twenty-five miles away from the valley bottoms, the loss to the banks goes as high as 15 per cent. In the directly affected districts the bankers have to renew practically all of the local paper in addition to which other funds are required to take care of rehabilitation and current needs,

such as taxes, interest, etc. The bank deposits in Scott County were reduced over 25 per cent and thousands of dollars worth of bonds which were held as savings have had to be sold on the market to aid in liquidating losses.

In Lawrence County the loss on each flood would probably run one-half a million dollars.

In Mason County the bank resources and clearings in the eastern half of the county which is not in the area of the floods decreased 10 per cent, while in the directly affected area the loss was 20 per cent. Pike County's loss in clearings and resources is about 25 per cent, while in Greene County a loss of 40 per cent is recorded.

From this survey it is our opinion that no profit has been possible for either landlords or tenants operating lands subject to overflow in the years mentioned. As a direct result, banks serving such territory have suffered withdrawal of practically all deposits of those customers and have been unable to collect a large percentage of their interest, and has made necessary a further extension of time on loans made and of additional credit. The effect is the weakening of confidence and a withdrawal of an uncertain amount of credit from river bottom lands.

Levees:

The location and extent of levees is shown on the attached map. These levees were built by the land owners either as individuals or as groups in Drainage and Levee Districts organized under the laws of the State which laws up to June 10, 1911, vested final authority for the location and construction of levees in the county courts. Since 1917, levee construction in the State of Illinois has been subject to the approval of the Division of Waterways of the Department of Purchases and Construction, successor to the Department of Public Works and Buildings. The construction of levees for land reclaimed was paid for by private owners or by assessments levied by the Drainage and Levee Districts.

Along the Mississippi River, the Federal government contributed to the expense of the construction of a few miles of levee through the Mississippi River Commission under the Federal laws governing that commission. No contributions have been made by the State for the construction of levees for land reclamation. Such contributions are barred by the provisions of the State Constitution. Contributions of $2,237,000.00 have been made by the State for the protection of cities and flooded areas as follows:

City.	Year.	State.	Other Resources.	Total.
Beardstown	1927	$350,000		$ 350,000
Cairo—Prior to	1913	?	$1,546,000	
"	1913	$250,000	168,000	
"	1915	25,000		
"	1927	250,000		
				2,239,000
Mounds	1927	$ 7,000		7,000
Mound City	1913	50,000		
" "	1915	10,000		
" "	1927	12,000		
				72,000
Naples	1913	$3,000		
"	1926	8,847		
				11,847
Shawneetown	1913	$39,000		
"	1915	10,000		
				49,000
Levied farm lands:				
Under contract	1927	$282,000		
Funds available	1927	949,000		
				1,231,000
				$3,959,847

The State of Illinois, with the appropriation under S. B. 576 attached, will repair damages to levees so as to provide protection against ordinary floods until such time as permanent control projects can be completed.

Federal Legislation Needed:

Acting upon my suggestion and, in accordance with the request contained in a special message to the members of the Fifty-fifth General Assembly, representing the people of the State of Illinois, the legislature, on June 15, 1927, by joint resolution, adopted a "memorial and petition, addressed to the President and Congress of the United States, suggesting the enlargement and extension of the powers and duties of the Mississippi River Commission to include the territory drained by the Illinois River and other tributaries of the Mississippi in the matter of flood control and protection; and also that a new Federal commission, including representatives of the various States

Mississippi River Levee of Cairo Drainage District, flood of 1927, showing sandbagging along inside toe to prevent sloughing.

in the flood area, be created, either by appointment of the President, or by an Act of Congress, to give immediate attention to the problem of flood control and the utilization of flood waters as far as practicable to the development of the material resources of our country."

How Can Flood Problem be Solved:

It is believed that the flood problem of the Mississippi River and its tributaries can best be solved by a National commission with which should cooperate the States which are effected. The other questions on pages 4 and 5 of the questionaire of the flood control committee can best be answered by a National commission charged with a solution of the problem.

TABULATION OF REPORTS SHOWING ESTIMATED LOSSES AND DAMAGES DUE TO FLOODS.

Drainage and levee district and county.	Year.	Damage to levees.	Fighting floods.	*Crop losses.	**All other damage.	District totals for years shown.
Armstrong (private)	1922	$ 400	$ 200	$ 2,000	$ 500	$3,100
Cass County	1926	850	250	4,000	1,200	6,300
365 acres	1927	200	100	4,200	800	5,300
Total						$14,700

TABULATION OF REPORTS SHOWING ESTIMATED LOSSES AND DAMAGES DUE TO FLOODS—Continued.

Drainage and levee district and county.	Year.	Damage to levees.	Fighting floods.	*Crop losses.	**All other damage.	District totals for years shown.
Banner Special	1922	$18,686	$2,500	----------	$ 2,700	$ 23,886
Peoria and Fulton Counties	1926	74,000	5,000	99,000	20,000	198,000
4,000 acres	1927	30,000	2,000	109,000	12,200	153,200
Total						$375,086
Big Swan	1922	$ 1,000	$ 5,000	$205,000	$12,000	$223,000
Scott County	1926	40,000	35,000	450,000	15,000	540,000
12,000 acres	1927					
Total						$763,000
Big Lake	1922	$20,000	$3,500	----------	----------	23,500
Schuyler County	1926	----------	3,000	----------	----------	3,000
3,300 acres	1927	----------	2,500	----------	----------	2,500
Total						$29,000
Cairo	1922	$ 2,500	$ 1,000	$150,000	$110,000	$263,500
Alexander County	1926	500	1,000	1,000	2,500	5,000
6,440 acres	1927	300,000	300,000	165,000	150,000	915,000
Total						$1,183,500
Chandlerville	1922	$3,500	$ 850	$20,400	$2,000	$26,750
Cass County	1926	2,600	1,500	16,400	1,000	21,500
2,000 acres	1927	650	300	26,500	3,000	30,450
Total						$78,700
Chautauqua	1922	$100,000	----------	----------	----------	$100,000
Mason County	1926	125,000	$2,500	$75,000	$50,000	252,500
3,800 acres	1927	20,000	----------	----------	----------	20,000
Total						$372,500
Chouteau, Nameoki and Venice	1922	$25,000	$3,500	$12,500	$1,000	$19,500
Madison County	1926	----------	----------	----------	----------	----------
17,500 acres	1927	4,500	6,000	25,000	3,000	38,500
Total						$58,000
Chouteau Island	1922	$ 3,937	$271	$ 9,000	----------	$13,208
Madison County	1926	----------	----------	----------	----------	----------
2,037 acres	1927	26,703	673	68,000	$33,000	128,376
Total						$141,584
Clear Creek	1922	$ 5,000	$1,000	$200,000	$10,000	$216,000
Union County	1926	1,000	----------	50,000	5,000	56,000
19,130 acres	1927	60,000	2,000	350,000	15,000	427,000
Total						$699,000
Clear Lake Special	1922	$22,600	$1,500	$40,000	$ 5,000	$69,100
Cass County	1926	30,000	1,650	17,000	45,000	93,650
3,664 acres	1927					
Total						$162,750
Coal Creek	1922	$125,000	$ 4,000	$209,000	$135,000	$473,000
Schuyler County	1926	5,000	13,000	60,000	----------	78,000
6,800 acres	1927	5,000	12,000	160,000	----------	177,000
Total						$728,000
Cohen Bros. (private)	1922	$3,000	$300	$ 7,000	$1,000	$11,300
Randolph County	1926	500	100	2,000	----------	2,600
1,000 acres	1927	6,000	400	10,000	2,500	18,900
Total						$32,800

TABULATION OF REPORTS SHOWING ESTIMATED LOSSES AND DAMAGES DUE TO FLOODS—Continued.

Drainage and levee district and county.	Year.	Damage to levees.	Fighting floods.	*Crop losses.	**All other damage.	District totals for years shown.
Columbia	1922	$ 2,500	$2,500	$ 10,000	$10,000	$25,000
Monroe County	1926	2,500	2,500	10,000	10,000	25,000
15,000 acres	1927	20,000	5,000	100,000	75,000	200,000
Total						$250,000
Coon Run	1922					
Morgan and Scott Counties	1926	$1,200		$50,000	$5,000	$56,200
4,500 acres	1927			25,000		25,000
Total						$81,200
Crabtree	1922	$ 1,000				$ 1,000
Fulton County	1926	12,000	$800	$30,000		42,800
1,200 acres	1927			40,000	$2,000	42,000
Total						$85,800
Crane Creek	1922	$90,000	$5,000	$120,000	$18,000	$233,000
Schuyler County	1926	16,000	19,000	60,000	6,000	101,000
5,000 acres	1927	12,000	4,000	60,000	6,000	82,000
Total						$416,000
Degognia and Fountain Bluff	1922	$30,000	$25,000	$600,000		$655,000
Jackson County	1926	10,000				10,000
29,260 acres	1927	75,000	25,000	600,000		700,000
Total						$1,365,000
East Liverpool	1922	$35,000	$2,000			$37,000
Fulton County	1926	50,000	1,500	$200,000	$10,000	261,500
3,300 acres	1927					
Total						$298,500
Fairbanks	1922	$150,000		$250,000	$50,000	$450,000
Greene County	1926	5,000	$2,000	150,000	10,000	167,000
8,000 acres	1927			40,000		40,000
Total						$657,000
Farmers	1922	$5,000	$3,500	$6,500		$15,000
Mason and Cass Counties	1926	25,000	5,000	20,000		50,000
9,100 acres	1927	3,500	750	7,500		11,750
Total						$76,750
Fort Chartress and Ivy Landing	1922					
Monroe County	1926					
10,500 acres	1927	$3,000	$1,724	$49,900	$5,200	$59,824
Hager Slough	1922	$2,000		$150,000	$20,000	$172,000
Cass County	1926	4,000		200,000	40,000	244,000
3,240 acres	1927	4,000		150,000	20,000	174,000
Total						$590,000
Harrisonville and Ivy Landing	1922		$3,000	$ 5,000	$ 5,000	$ 13,000
Monroe County	1926			2,000	1,000	3,000
1,800 acres	1927	$5,000	4,500	301,750	22,500	333,750
Total						$349,750
Hartwell	1922	$200,000		$300,000	$50,000	$550,000
Greene County	1926		$1,000	160,000		161,000
8,800 acres	1927			50,000		50,000
Total						$761,000
Hennipen	1922					
Putnam County	1926			$831,600	$1,759,200	$2,590,800
2,585 acres	1927					

TABULATION OF REPORTS SHOWING ESTIMATED LOSSES AND DAMAGES DUE TO FLOODS—Continued.

Drainage and levee district and county.	Year.	Damage to levees.	Fighting floods.	*Crop losses.	**All other damage.	District totals for years shown.
Hillview	1922	$15,000	$20,000	$75,000	----------	$110,000
Greene and Scott Counties	1926	40,000	60,000	210,000	----------	310,000
12,300 acres	1927	5,000	20,250	135,000	----------	160,250
Total	----------	----------	----------	----------	----------	$580,250
Jobs Creek	1922	$1,000	----------	$5,000	$1,000	$7,000
Cass County	1926	7,000	$300	10,000	5,000	22,300
1,440 acres	1927	14,000	500	18,000	10,000	42,500
Total	----------	----------	----------	----------	----------	$71,800
Kaskaskia Island	1922	$ 2,500	$ 500	$ 50,000	$60,000	$113,000
Randolph County	1926	500	----------	5,000	25,000	30,500
10,000 acres	1927	50,000	4,000	150,000	75,000	279,000
Total	----------	----------	----------	----------	----------	$422,500
Kerton Valley	1922	----------	$ 400	----------	----------	$ 400
Fulton County	1926	----------	500	$76,000	$ 300	76,800
1,700 acres	1927	$6,000	1,200	85,000	18,000	110,200
Total	----------	----------	----------	----------	----------	$187,400
Lacey	1922	----------	$12,000	----------	----------	$ 12,000
Fulton County	1926	$130,000	6,000	$60,000	$60,000	256,000
3,000 acres	1927	----------	----------	89,000	----------	89,000
Total	----------	----------	----------	----------	----------	$357,000
Langellier	1922	$10,000	$15,000	----------	----------	$ 25,000
Fulton County	1926	45,000	1,000	$65,000	$30,000	141,000
2,050 acres	1927	5,000	----------	65,000	Inc. above	70,000
Total	----------	----------	----------	----------	----------	$236,000
Little Creek	1922	$5,000	$2,000	$20,000	$10,000	$37,000
Brown County	1926	7,000	1,000	25,000	15,000	48,000
2,000 acres	1927	1,000	----------	30,000	5,000	36,000
Total	----------	----------	----------	----------	----------	$121,000
Liverpool	1922	----------	----------	----------	----------	----------
Fulton	1926	$10,142	$17,163	$20,000	$50,000	$97,305
3,300 acres	1927					
Lost Creek	1922	$14,000	$1,800	$32,000	$27,000	$74,800
Cass County	1926	10,000	500	36,000	----------	46,500
2,951 acres	1927	20,000	300	22,000	----------	42,300
Total	----------	----------	----------	----------	----------	$163,600
Lower Indian Creek	1922	$2,000	----------	$10,000	$1,000	$13,000
Cass County	1926	3,000	$500	20,000	----------	23,500
2,300 acres	1927	3,000	----------	35,000	----------	38,000
Total	----------	----------	----------	----------	----------	$74,500
Lower Salt Creek	1922	$10,000	$15,000	$100,000	$10,000	$135,000
Logan County	1926	25,000	50,000	200,000	50,000	325,000
10,900 acres	1927	----------	25,000	125,000	10,000	160,000
Total	----------	----------	----------	----------	----------	$620,000
McGee Creek	1922	$20,000	$25,616	$125,000	----------	$170,616
Pike and Brown	1926	28,000	6,000	351,510	$ 47,000	432,510
10,800 acres	1927	27,000	800	400,000	100,000	527,800
Total	----------	----------	----------	----------	----------	$1,130,926
McNiel Farm (private)	1922	$300	$1,000	$ 5,000	$2,000	$ 8,300
Cass County	1926	1,000	300	10,000	2,000	13,300
160 acres	1927	200	----------	10,000	2,000	12,200
Total	----------	----------	----------	----------	----------	$33,800

TABULATION OF REPORTS SHOWING ESTIMATED LOSSES AND DAMAGES DUE TO FLOODS—Continued.

Drainage and levee district and county.	Year.	Damage to levees.	Fighting floods.	*Crop losses.	**All other damage.	District totals for years shown.
Mason and Cass River	1922	----------	----------	$4,000	----------	$4,000
Mason and Cass Counties	1926	----------	----------	8,500	----------	8,500
10,840 acres	1927					
Total	----------	----------	----------	----------	----------	$12,500
Mason and Menard	1922	$ 1,500	$1,000	$15,000	$15,000	$ 32,500
Mason and Menard Counties	1926	20,000	4,000	60,000	20,000	104,000
7,000 acres	1927	2,000	2,000	40,000	20,000	64,000
Total	----------	----------	----------	----------	----------	$200,500
Mauvaisterre	1922	----------	----------	$30,000	$10,000	$40,000
Scott County	1926	$10,000	$2,000	25,000	10,000	47,000
4,000 acres	1927	9,000	2,500	15,000	15,000	41,500
Total	----------	----------	----------	----------	----------	$128,500
Meredosia Lake	1922	$35,000	$10,000	$ 62,300	$15,000	$122,300
Cass and Morgan Counties	1926	30,000	10,000	75,000	10,000	125,000
3,761 acres	1927	10,000	8,000	120,000	15,000	153,000
Total	----------	----------	----------	----------	----------	$400,300
Middle Creek No. 1	1922	$200	$100	$ 7,660	$300	$ 8,260
Cass County	1926	400	200	15,320	400	16,320
1,100 acres	1927	800	300	16,410	200	17,710
Total	----------	----------	----------	----------	----------	$42,290
Moredock and Ivy Landing	1922	$20,000	$8,000	$100,000	----------	$128,000
Monroe County	1926	----------	----------	----------	----------	----------
16,700 acres	1927	----------	----------	----------	----------	----------
Mounds	1922	----------	----------	$15,000	$ 60,000	$ 75,000
Pulaski County	1926	----------	----------	----------	----------	----------
720 acres	1927	----------	----------	25,000	550,600	575,600
Total	----------	----------	----------	----------	----------	$650,600
New Pankey's Pond Special	1922	----------	----------	----------	----------	----------
Cass and Morgan Counties	1926	$9,000	$200	$15,125	$ 5,000	$29,325
1,432 acres	1927	2,000	300	30,000	10,000	42,300
Total	----------	----------	----------	----------	----------	$71,625
North Fork (outlet)	1922	$10,000	$2,000	$225,000	$10,000	$247,000
Christian-Macon-Sangamon	1926	5,000	1,000	450,000	30,000	486,000
10,680 acres	1927	5,000	1,000	225,000	30,000	261,000
Total	----------	----------	----------	----------	----------	$994,000
Oakes (private)	1922	$ 500	$75	$17,640	$1,120	$19,335
Scott County	1926	450	25	11,850	1,200	13,525
650 acres	1927	4,200	----------	24,430	1,400	30,030
Total	----------	----------	----------	----------	----------	$62,890
Oakford Special	1922	----------	----------	----------	----------	----------
Menard County	1926	$15,000	$2,500	30,000	$15,000	$62,500
2,300 acres	1927	1,000	500	20,000	----------	21,500
Total	----------	----------	----------	----------	----------	$84,000
Oakford (private)	1922	----------	----------	----------	----------	----------
Menard County	1926	$6,000	$200	$45,000	----------	$51,200
325 acres	1927					
Osborne (private)	1922	$1,000	----------	$1,000	----------	$ 2,000
Logan County	1926	8,000	----------	5,200	----------	13,200
400 acres	1927	3,000	----------	6,800	----------	9,800
Total	----------	----------	----------	----------	----------	$25,000

TABULATION OF REPORTS SHOWING ESTIMATED LOSSES AND DAMAGES DUE TO FLOODS—Continued.

Drainage and levee district and county.	Year.	Damage to levees.	Fighting floods.	*Crop losses.	**All other damage.	District totals for years shown.
Pekin and LaMarsh	1922	$115,000	$5,000	$ 70,000	$10,000	$200,000
Peoria County	1926	50,000	4,000	100,000	6,000	160,000
2,721 acres	1927					
Total						$360,000
Prairie DuPont	1922					
St. Clair and Monroe Counties	1926					
5,700 acres	1927	$3,000	$1,627	$45,000	$5,000	$54,627
Preston	1922	$20,000	$7,000	$100,000	10,000	137,000
Union County	1926					
16,200 acres	1927	50,000		75,000	40,000	165,000
Total						$302,000
Salt Creek	1922	$10,000	$ 2,000	$ 25,000		$ 37,000
Mason and Menard Counties	1926	40,000	10,000	273,000		540,000
11,000 acres	1927			217,000		
Total						$577,000
Seahorn	1922	$2,500	$4,000	$ 5,000		$11,500
Fulton County	1926	5,000	6,000	15,000	$50,000	76,000
1,743 acres	1927	1,000	3,000	10,000	36,200	50,200
Total						$137,700
Scott County	1922	$100,000	$5,000	$200,000	$100,000	$405,000
Scott County	1926	25,000	6,000	225,000	100,000	356,000
10,230 acres	1927			225,000		225,000
Total						$986,000
Spoon River	1922	$1,500	$500	$20,000	$2,000	$24,000
Fulton County	1926	2,000	300	18,000	1,000	21,300
2,500 acres	1927	2,500	400	30,000	1,500	34,400
Total						$79,700
Spring Lake	1922	$96,000	$16,000			$112,000
Tazewell County	1926	25,000	12,000			37,000
12,100 acres	1927	25,000	14,000			39,000
Total						$188,000
South Beardstown	1922	$2,000	$1,000	$ 500	$2,000	$5,500
Cass County	1926	1,000	2,000	1,000	2,000	6,000
8,100 acres	1927	1,000	500	2,000	2,000	5,500
Total						$17,000
Stringtown	1922					
Monroe and Randolph	1926					
3,000 acres	1927	$2,000	$734	$14,000	$6,400	$23,134
Ten Mile	1922	$12,000		$18,000		$30,000
Tazewell County	1926	5,000		9,000		14,000
330 acres	1927			4,000		4,000
Total						$48,000
Turner (private)	1922		$100	$5,000		$ 5,100
Tazewell County	1926	$4,000	250	8,000		12,250
2,500 acres	1927			9,000		9,000
Total						$26,350

TABULATION OF REPORTS SHOWING ESTIMATED LOSSES AND DAMAGES DUE TO FLOODS—Concluded.

Drainage and levee district and county.	Year.	Damage to levees.	Fighting floods.	*Crop losses.	**All other damage.	District totals for years shown.
Turner and Crabb	1922	$3,000	$2,000	$4,000	----------	$ 9,000
	1926	2,500	150	8,000	----------	10,650
2,000 acres	1927	----------	----------	6,000	----------	6,000
Total	----------	----------	----------	----------	----------	$25,650
Turner and Hergete	1922	$ 5,000	$1,500	----------	----------	$ 6,500
Mason County	1926	20,000	1,000	$22,500	----------	43,500
2,500 acres	1927	----------	500	32,000	----------	32,500
Total	----------	----------	----------	----------	----------	$82,500
Valley	1922	$11,000	$ 8,000	$ 8,000	$ 5,000	$32,000
Cass County	1926	5,000	10,000	25,000	10,000	50,000
3,200 acres	1927	5,000	7,500	30,000	5,000	47,500
Total	----------	----------	----------	----------	----------	$129,500
Valley City	1922	$ 9,500	$7,650	$ 5,000	$15,000	$ 37,150
Pike County	1926	10,000	2,500	90,000	10,000	112,500
4,800 acres	1927	15,000	5,250	50,000	10,000	80,250
Total	----------	----------	----------	----------	----------	$229,900
West Matanzas	1922	$10,000	$10,000	----------	----------	$ 20,000
Fulton County	1926	50,000	1,500	$100,000	$30,000	181,500
2,700 acres	1927	10,000	500	100,000	Inc. above	110,500
Total	----------	----------	----------	----------	----------	$312,000
George White (private)	1922	$1,500	$300	$3,000	$9,000	$13,800
Logan County	1926	3,000	400	2,500	8,000	13,900
100 acres	1927	3,500	150	2,500	6,000	12,150
Total	----------	----------	----------	----------	----------	$39,850
Winchester (private)	1922	----------	----------	----------	----------	----------
Scott County	1926	$3,093	----------	$25,000	----------	$28,093
450 acres	1927					

* "Crop Losses" includes the value of crops actually destroyed and also losses from failure to make a crop due to flood conditions.

** "Other Damages" includes loss and damage to others outside the district due to flood in that district as well as that district losses.

SUMMARY.

Reported losses from flooded areas and Drainage and Levee Districts aggregating 399,204 acres—Total.....$22,814,734.00

Estimated losses for areas and Drainage and Levee Districts not heard from aggregating 48,135 acres (figured on the average loss per acre of those reported)—Total..... 2,833,783.00

Grand Total $25,648,517.00

TABULATION OF REPORTS GIVING INFORMATION ON FLOOD LOSSES, IN CITIES ONLY.

City of East Peoria (combined for 1926 and 1927 only).

Public utilities.	Municipal property.	Schools.	Homes.	Total.
$187,000	$98,000	$8,500	$115,000	$408,500
Manufacturing interests.	**Wholesale and retail business.**	**Fighting flood.**	**Damage to levees.**	**Total.**
$844,000	$48,000	$12,000	$20,000	$924,000
Pumping water out of levee district.	**All other damages.**			**Total.**
$25,000	$45,000			$70,000
Total				$1,402,500

Mound City—

	Public utilities.	*Municipal losses.	Schools.	Homes.	Total.
1922	$20,000		$1,000	Not given.	$21,000
1926				Not given.	
1927	100,000	400,000	5,000	Not given.	505,000
	Manufacturing interests.	**Wholesale and retail interests.**	**Fighting flood.**	**Damage to levees.**	**Total.**
1922	$ 25,000	$ 25,000	$4,000	$10,000	$ 64,000
1926			1,000		1,000
1927	250,000	200,000	8,000	75,000	533,000

Total losses for 1922	$ 85,000
Total losses for 1926	1,000
Total losses for 1927	1,038,000
Total	$1,124,000

* Includes decline in real estate valuations.

Beardstown (combined for 1926-1927 only).

Public utilities.	Municipal Property.	Schools.	Homes.	Total.
$30,000	$15,000	$25,000	$100,000	$170,000
Manufacturing interests.	**Wholesale and retail business.**	**Fighting floods.**	**Levees.**	**Total.**
$25,000	$100,000	$50,000	$396,000	$571,000
Total				$741,000
Total reported from cities				$3,267,500

TABULATION OF FLOOD LOSSES REPORTED BY RAILROADS.

Several roads, other than those listed, report that, while they had no direct loss or damage, they were subject to considerable indirect loss due to depressed business conditions in the areas affected and also the fact that when the business is once lost, it requires six to twelve months to regain the confidence of the shippers.

This amount is somewhat undetermined, but if combined, might be placed at close to $2,000,000.00.

Chicago & North Western Railroad—

Year.	Direct loss.	*Indirect loss.	Miles of road-bed damaged.	Number of bridges damaged.
1922	$25,000	$20,000	2½	3
1926	30,000	40,000	7	8
1927	35,000	50,000	4½	5
Total	$90,000	$110,000	14	16

Remarks { 1922—
1926—
1927—

Illinois Traction System—

Year.	Direct loss.	*Indirect loss.	Miles of road-bed damaged.	Number of bridges damaged.
1922	$44,318	$60,000	.7	4
1926	30,758	6,000	.4	3
1927	91,692	16,000	.3	----------
Total	$166,768	$82,000	1.4	7

Remarks { 1922—Traffic completely interrupted Spring Valley to Princeton, Aug. 8 to Dec. 1.
1926—
1927—Freight traffic, particularly, demoralized for a considerable period.

Illinois Central System—

Year.	Direct loss.	*Indirect loss.	Miles of road-bed damaged.	Number of bridges damaged.
1922	$ 17,000	Not estimated but said to be enormous.	27	2
1926	None		None	None
1927	222,400		32	4
Total	$239,400		59	6

Remarks { 1922—All traffic Murphysboro-St. Louis division interrupted for about 30 days.
1926—
1927—Complete interruption of all traffic Grand Tower, Thebes, Mounds, Mound City from April 15th to May 15th.

TABULATION OF FLOOD LOSSES REPORTED BY RAILROADS—Concluded.

Cleveland, Cincinnati, Chicago & St. Louis (Big Four) R. R.—

Year.	Direct loss.	*Indirect loss.	Miles of road-bed damaged.	Number of bridges damaged.
1922	$ 4,500	Not estimated but said to be enormous.	4	2
1926	None		None	None
1927	50,000		8	0
Total	$54,500		12	2

Remarks
1922—Flood did not materially affect traffic.
1926—Flood did not materially affect traffic.
1927—All traffic entirely out of service in Cairo district for nine days.

Chicago, Burlington & Quincy R. R.—

Year.	Direct loss.	*Indirect loss.	Miles of road-bed damaged.	Number of bridges damaged.
1922	$141,000	Not estimated but said to be enormous.	12	0
1926	147,000		12	0
1927	41,000		12	1
Total	$329,000		36	1

Remarks
1922—All traffic completely interrupted from Browning to Beardstown for eight days.
1926—All traffic completely interrupted from Browning to Beardstown for twelve days. Coal traffic from southern Illinois had to be detoured via B. & O. to East St. Louis, Galesburg and Quincy at greatly increased cost. Approximately 4,000 cars of coal were lost.
1927—Traffic seriously interrupted, Browning to Beardstown.

Total losses of five railroads—

Direct loss	$879,668
Indirect loss	192,000
Total	$1,071,668

RECAPITULATION OF FLOOD LOSSES REPORTED FROM VARIOUS SOURCES.

Drainage and Levee Districts and areas affected by floods report losses and damages totaling	$25,648,517.00
Cities in flooded areas report losses and damages totaling	3,267,500.00
Reported losses of railroads operating in flooded areas report direct and indirect losses totaling	1,071,668.00
Division of Highways report losses from damage to State roads totaling	750,000.00
Grand Total	$30,737,685.00

HUGHES' REPORT RE DIVERSION OF WATER.

As recorded in our last annual report, for the year ending June 30, 1927, engineers of the Division of Waterways devoted considerable time during that fiscal year in preparing data and in presenting evidence at the lake level hearings, held in Washington by Charles Evans Hughes, former Justice of the United States Supreme Court, who, on June 7, 1926, by order of said court, had been appointed Special Master to take testimony and report to the court his conclusions of law and fact in the

case of the so-called lake states to enjoin the State of Illinois and the Sanitary District of Chicago from diverting water from Lake Michigan into the Mississippi watershed.

The original bill was filed by the State of Wisconsin in 1922 and is still pending. The report and conclusions of the Special Master was filed during the October term, 1927. Because of the importance of this litigation a brief review thereof, abstracted from a report by Attorney Cornelius Lynde to the Chicago Association of Commerce, and published in "Chicago Commerce," December 3, 1927, is included herein.

THE FEDERAL SUIT OF 1908.

Early in 1908, the General Assembly of Illinois, at a special session, voted to submit to popular vote a proposed amendment to the State Constitution authorizing a bond issue of $20,000,000 for the construction of a deep waterway from the end of the Sanitary and Ship Canal at Lockport, 35 miles from Chicago, to connect with the navigable waters of the Illinois River near Utica, Illinois.

While this question was pending, and prior to the November election of 1908, a so-called friendly suit was filed by the Federal government in the United States District Court at Chicago to enjoin the Sanitary District of Chicago from diverting more water for sewage dilution than had been authorized in 1903-5 by the Secretary of War, viz., 4,167 cubic feet per second. The Sanitary District, operating under a law of Illinois which required dilution of sewage on the basis of population, was obligated to use an average in excess of 8,500 cubic feet per second. Wisconsin and other complainant states intervened as friends of the United States in the above Federal suit, which was finally decided in 1925 in favor of the Government by the United States Supreme Court which sustained the position of the War Department and entered a decree enjoining the Sanitary District from exceeding the permit of the Secretary of War, but without prejudice to any new permit the Secretary might issue in accordance with law.

The decree, by order of the court, did not go into effect for 90 days, and within that time the Sanitary District made application for a new permit. After public hearing and earnest consideration, on March 3, 1925, the then Secretary of War, Mr. Weeks, granted the present permit, authorizing a diversion of 8,500 c.f.s. and attaching many and onerous conditions, which Judge Hughes finds in his decision have been lived up to.

LAKE STATES NOT SATISFIED.

The lake states were not satisfied with the decision of the Secretary of War, and in October, 1925, the State of Wisconsin, together with Minnesota, Ohio and Pennsylvania, filed an amended bill in which they sought to enjoin any diversion whatever, and alleged that the permit of the Secretary of War was invalid as in excess of lawful authority. The only injury claimed by these complaining states was the alleged injury to navigation due to claimed lowering of the levels of the Great Lakes produced by the diversion. Thereafter the State of Michigan filed a bill containing practically the same averments as the Wisconsin bill, but

setting forth riparian damage, that is, a claim of injury to docks, wharves, bathing beaches, fishing grounds, etc. And later the State of New York filed a similar bill containing both grounds and raising a further issue as to injury to power rights, which subsequently the Supreme Court, on motion of the defendants, dismissed without prejudice from the proceeding.

In due course answers were filed and the Mississippi Valley States of Missouri, Kentucky, Tennessee and Louisiana, came in upon petition and obtained leave to be joined as defendants with Illinois and the Sanitary District in opposing the granting of any decree to cut off the diversion.

ALL RIVER STATES SUPPORT DIVERSION.

When these complaining states had intervened in the government case the Chicago Association of Commerce brought to the attention of the Mississippi Valley states their interest in the diversion by reason of its beneficial effect upon navigation in the Lakes-to-the-Gulf Waterway, down the Illinois River and the Mississippi. And these four states obtained leave to appear as friends of the court on the side of Illinois in the government case.

In addition to the aforementioned, the States of Mississippi and Arkansas subsequently came in, adopting as their own the answer previously filed on behalf of the original four Mississippi states. Thus every state on the Mississippi from Illinois to its mouth appeared before the Supreme Court to oppose the cessation of the diversion. Subsequently Charles Evans Hughes was appointed Special Master to hear the case, and the matter was on hearing during a large part of last winter, being argued before the Special Master early in June (1927).

His report follows the direction of the court and makes findings of fact, presents his conclusions of law, and his recommendation for a decree, which is that the bills be dismissed, in view of his decision that the complainants are not entitled to the relief sought, but without prejudice to the right of the complainants to institute a suit to prevent a diversion from Lake Michigan, in case such diversion be made or attempted without authority of law. In other words, the right is reserved to these states to commence suit anew if Illinois should seek to divert water without a permit from the Secretary of War or other Federal authority.

A COMPREHENSIVE REVIEW OF ISSUES.

The Special Master's report, consisting of 197 printed pages, is a complete and comprehensive review of all of the issues presented, and reaches a conclusion upon practically every contention advanced by either side. The findings begin with a description of the site of the drainage canal, stressing the fact that the continental divide separating the St. Lawrence and Mississippi watersheds at its lowest point is only some 10 miles from the shore of Lake Michigan, and not in excess of 10 feet above the level of the lake.

The Master finds that in earlier ages Lake Michigan had an outlet to the south, and finds that during the period of exploration of this western country the route of the drainage canal, which was a marsh

connecting the headwaters of the Chicago River and the DesPlaines River, formed a natural thoroughfare for the Indians and later explorers and the French *coureurs de bois.*

The Master finds as to the history of the Illinois and Michigan Canal, which was commenced pursuant to Acts of Congress in 1822 and 1827, originally intended as a water level canal connecting the waters of Lake Michigan with those of the Illinois River, by reason of lack of funds was made with locks lifting the water over the height of land, and later on in order to remove pollution from the Chicago River, which from the beginning had served as the sewer of the city, was deepened in accordance with the original plan.

PUMPS PROVE INSUFFICIENT.

By 1871 the flow was insufficient to solve the sewage necessities, and pumps were installed. But the growth of the city and coincident lowering of the levels of the Great Lakes prevented these measures from being sufficient, as the canal was naturally small, and by 1880 it was clear that some solution for the sanitary difficulties of this rapidly growing city was necessary.

The report goes into the history of the Sanitary District, and finds that the plan by which water from the lake was to be diverted in sufficient volume to dilute sewage and thus prevent the pollution of Chicago's water supply was the result of careful study. The report pays considerable attention to the various Acts of Congress, taking note of the existence of the District, making appropriations for the deepening of the Chicago River in order to accommodate it for the reversal of flow, in accordance with the plan of the District, and in main sustaining the contentions of the defendants as to the history of Federal action, in connection with this controversy prior to the permit of March 3, 1925. *The Special Master finds as a fact that the defendants have complied substantially with the conditions of the permit since its issuance.*

EFFECT OF DIVERSION ON LAKE LEVELS.

As to the effect of the diversion on the level of the Great Lakes the Special Master finds that the levels have been affected by the following artificial factors: The regulating works in the St. Marys River at the outlet of Lake Superior, which have deprived the lower lakes of the natural flow from Lake Superior; the diversion of the Chicago Sanitary District from Lake Michigan; diversions from Lake Erie for power and navigation, through the Welland Canal, and from the Niagara River; and changes in the discharge capacity of the St. Clair River at the outlet of Lake Huron, as a result of which an increasing volume of water has been drawn off from Lakes Huron and Michigan; and similar changes in the St. Lawrence River; affecting the level of Lake Ontario.

INJURY NOT ASCERTAINABLE.

In addition to that the Master finds as a matter of fact that there are constant fluctuations in the levels of the lakes due to changes in rainfall and evaporation, as a result of which, based upon expert testimony as to a highly complicated problem, the Special Master finds that the full effect of the present diversion would be to lower the levels of

Lake Michigan and Huron approximately six inches at mean levels; Lakes Erie and Ontario five inches; and similarly, of course, the levels of connecting rivers, bays and harbors. The Master found that this effect would in fact produce injury to navigation conducted on the Great Lakes but that the amount of this injury which could be apportioned to the Chicago diversion, in view of the fact that material lowering of the levels was contributed to by other causes, was impossible of ascertainment.

The Master also found that the complainant states' claim of injury to horticultural interests due to the change in the levels of the lakes was not proved, but that in addition to the injury to navigation there was injury to riparian rights.

DIVERSION AIDS MISSISSIPPI RIVER NAVIGATION.

The Mississippi Valley states and the State of Illinois contended that the water diverted from Lake Michigan through the Sanitary District Canal was highly beneficial to navigation on the Illinois River and on the Mississippi from Grafton south. These contentions the report of the Special Master sustains. The Master found that the exact effect of the diversion upon the navigation of the Mississippi by reason of the constant variations in the flow of that stream and the tendency of bars to form in its silt laden current was difficult of exact appraisal but finds that the diversion, to some extent, during low water period increases navigable depths over the bars on the Mississippi and that it was permissible on all the facts for the Secretary of War to reach the conclusion that the diversion was an aid to the navigation of the Mississippi in times of low water.

It is worthy of note that the Mississippi Valley states offered in evidence a day to day record of the navigation operations of the government barge line on the Mississippi, and difficulties due to insufficient channel depth and width were found in each year of operation for considerable lengths of time, in some years as much as four or five months.

VALUE OF INLAND WATERWAYS.

The Master comments upon the value of inland water transportation on the Mississippi as an offset to the serious handicap produced by the Panama Canal, in the way in which the latter has afforded cheap rates for transportation from the Atlantic to the Pacific coasts, which cannot be met by the railroads serving the interior portions of the country; and further commented upon the value of this navigation in reducing the cost of moving agricultural products from the Mississippi Valley to seaboard for transportation to the world markets where the price of these commodities is fixed, and states that it may be assumed that these matters are of national interest and points out that Congress has given elaborate consideration to them.

REMEDIAL WORKS WILL REGULATE LEVELS.

The Master quotes the several reports of Federal engineers, to the effect that remedial works in the outlet channels of the Great Lakes will more than restore the level lost by the Chicago diversion, particularly quoting those portions of the last report of the Joint Board of Engineers

of the United States and Canada, in which it was found that the entire cost of these remedial works would not exceed $4,608,000.

CHICAGO'S SANITARY PROBLEMS.

In reference to Chicago's sanitary problem the following quotation from the report is of interest:

"It is plain that the present flow from Lake Michigan through the drainage canal could not be immediately cut off, or reduced to 1,000 c. f. s., and in consequence the sewage of the Sanitary District in its present condition turned into Lake Michigan, without exposing the inhabitants of the district to grave risk of water-borne diseases, by contamination of the water supply taken from the lake. The Chicago River and the waters of the lake about the city would be filthy and noisome, with serious injury to the commerce of Chicago harbor. It appears from the testimony that it would take several years, not less than five years and perhaps ten years, or even more, before the sewage of the district, with such treatment as is practicable, could be turned into the lake and the diversion from the lake stopped or greatly reduced, without serious risk to the health of the people of Chicago. If the work of sewage treatment is efficiently carried on, and is extended by the most approved methods, and additional and appropriate measures are taken for water purification, it appears to be possible largely to reduce or altogether to terminate the diversion from Lake Michigan, and still to give the city of Chicago a reasonable measure of immunity from disease through pollution of its water supply. Within what time this result could be achieved can not now be definitely determined.

QUESTIONS OF PUBLIC HEALTH INVOLVED.

"To secure the utmost practicable treatment of the sewage of the Sanitary District, and to reduce as rapidly as possible the diversion of water from Lake Michigan, without creating conditions which would seriously menace the health of Chicago, will require constant and expert administrative supervision, the continuous checking up of the results obtained by the installation of treatment works, and the insistence on such improved method as from time to time will be available. Apart from the question of authority, which will be considered later, I find upon the facts here shown that the recommendation of the chief of engineers, above set forth (referring to the conditions of the permit requiring the installation of sewage treatment) on the application for the permit of March 3, 1925, which under lay the conditions of that permit, was a reasonable one with respect to the measure immediately practicable.

"The complainants have recognized the impracticability of ordering an immediate cessation of the diversion, and the suggestion made in the closing argument on their behalf before the Special Master was that the court should determine the rights of the parties, and direct a discontinuance of the diversion, but should suspend the operation of the decree and hold it in the court with requirements from time to time as to the action, and the time, that should be taken to bring about a condition which would permit of the decree becoming effective."

QUESTIONS OF LAW INVOLVED.

In reference to the questions of law presented, the report defines these questions to be: Whether there is a justiciable controversy of which the Supreme Court could take jurisdiction; whether the State of Illinois had the right to divert the waters of Lake Michigan in the manner shown without the consent of the United States; whether Congress has the authority to control the diversion and to regulate it; and whether the Secretary of War, as the agent of Congress, had the authority to grant the permit of March 3, 1925, under the Act of 1899.

The report concludes that there was a justiciable controversy, in the light of previous decisions of the Supreme Court in controversies between states similar in nature to the one presented. The Master points out that the defendants, Illinois and Sanitary District, both stated in their answers in this case that they could not divert water and did not intend to divert water except by and with the authority of the United States, according to law. And the Master concludes that Illinois has no such authority without the action of Congress or its agent, the Secretary of War, in view of the preceding decision of the Supreme Court on the suit of the government to enjoin the Sanitary District from diverting more than the amount specified in the earlier permit of the Secretary of War.

CONGRESS CAN REGULATE DIVERSION.

As to the authority of Congress to regulate the diversion, the decision is conclusive, dealing as it does with every contention made by the complainants and basing its conclusion upon a wealth of authority. The decision is to the effect that, under the commerce clause of the Constitution, Congress can regulate navigation, and as this diversion has beyond question in fact an effect upon navigation, the entire matter falls within the scope of Congressional authority. The riparian rights of the complainant states in the waters of the Great Lakes and the lands under those waters are all, according to the decision, held subject to the exercise of the paramount power of Congress to control and regulate navigation, and any damage resulting from acts performed pursuant to such Congressional authority are merely incidental damage for which the law does not allow compensation.

As to the right to divert water from the Great Lakes into the Mississippi for the purpose of aiding navigation, the report says:

> "If Congress decided that it was in the interest of the country as a whole to open and improve a waterway from Lake Michigan to the Mississippi River and the Gulf of Mexico, and for that purpose diverted water from Lake Michigan to the Mississippi watershed, there would seem to be no constitutional difficulty so far as the diversion is concerned. Its practicability, its amount, the effect on the Great Lakes-St. Lawrence watershed, and on the States bordering on the Great Lakes, the question where the balance of National interest lay after appropriate appraisal of all local interests and of international relations, would be matters for the consideration of Congress exercising the sovereign power of the nation in determining National policy."

The report holds that as a matter of fact Congress has not yet, in spite of many legislative enactments dealing with certain phases of this problem, finally authorized the diversion, but the decision is to the effect that by the Act of 1899 broad power to regulate matters of this kind was delegated to the Secretary of War, that this Act has been held to be constitutional and that the action of the Secretary in granting the permit of March 3, 1925, under which the diversion is now taking place, was within the lawful authority of the Secretary of War and was a reasonable exercise by him of that power.

CANADIAN TREATY NO BAR TO DIVERSION.

In reference to the effect of the treaty with Canada of 1909, upon which frequently stress is laid in newspaper and other articles concerning this historic controversy, the decision of the report would seem to be final and conclusive. Under the Constitution of the United States, a treaty duly authorized and approved by the Senate becomes the law of the land and is, of course, binding upon Federal officers. If there were anything in the treaty which tended to limit the authority of the Secretary of War to deal with this diversion and authorize it, as he did by the existing permit, it would have been the bounden duty of the Master to so declare, and to the extent that the permit exceeded the limitation imposed by the treaty to declare it unlawful. The report says:

"It does not seem to be necessary to discuss the provision of the treaty of 1909, or the reservations it contains, and I express no opinion upon them, further than to say that the treaty contains nothing which can be regarded as affecting a repeal of the Act of March 3, 1899, or as operating to deprive the Secretary of War of the authority it conferred in relation to the diversion here in question."

LAKE MICHIGAN A DOMESTIC WATER.

Among his findings of fact the Master quoted certain portions of the treaty, which show beyond dispute that Lake Michigan, being regarded as a domestic water of the United States and not an international water, was clearly excepted from the operation of the treaty. And the report quotes the statement of Secretary of State Elihu Root, as follows: "I have very carefully guarded the terms of this treaty in order not to include Lake Michigan."

In concluding these comments it is worth while to note that what appears to be one of the strongest reasons in the mind of the Special Master for his decision sustaining the authority of the Secretary of War, is his conclusion that the pollution of the Chicago harbor, which would result from a cessation of the diversion, materially concerned navigation and would produce a situation directly within the full scope of the Secretary of War's authority in this particular. The report says:

"In exercising his authority under the statute, it was incumbent upon the Secretary of War to consider the interests of navigation, but he was bound to consider those interests in relation to the Chicago River and the Chicago Harbor as well as in connection with the effect on other harbors and the levels of the lakes. * * * It appeared that a diversion of 4,167 c. f. s. was not sufficient to keep the Chicago River reversed at all times, and when not kept reversed, the enormous volume of Chicago's sewage would pour into the lake and under present conditions could not fail to create a pestilential condition in the lake, and in the port and harbor of Chicago. The nature of the injury which would be sustained by the interests of navigation and commerce, and the propriety of the intervention of the United States, in such a case were pointed out by the (Supreme) court in *New York* v. *New Jersey*, 256 U. S. 296."

And in conclusion the report says:

"If Congress had no power to regulate the diversion, or if it lay outside the authority delegated to the Secretary of War, he could not deal with it

at all; but if Congress had the power, and the Secretary of War had the administrative authority to regulate the diversion, there seems to me to be no basis for a decision that he transcended his authority in determining the quantity allowed or that his action is subject to judicial review." * * *

"The permit is in terms revocable at the will of the Secretary of War, and is subject to such action as may be taken by Congress. If not revoked, or extended, the permit is to expire on December 31, 1929. It seems to me that the Secretary of War had authority to impose these conditions." * * *

SUMMARY OF CONCLUSIONS.

My conclusions are:

"1. That the complainants present a justiciable controversy.

"2. That the State of Illinois and the Sanitary District of Chicago have no authority to make or continue the diversion in question without the consent of the United States.

"3. That Congress has power to regulate the diversion, that is, to determine whether and to what extent it should be permitted.

"4. That Congress has not directly authorized the diversion in question.

"5. That Congress has conferred authority upon the Secretary of War to regulate the diversion, provided he acts in reasonable relation to the purpose of his delegated authority and not arbitrarily.

"6. That the permit of March 3, 1925, is valid and effective according to its terms, the entire control of the diversion remaining with Congress."

RECOMMENDATIONS FOR DECREE.

"In the light of these conclusions, the bill, in my opinion, should be dismissed. I think, however, that if a situation should develop in which the defendants were seeking to create or continue a withdrawal of water from Lake Michigan without the sanction of Congress or of administrative officers acting under its authority, the complainant States have such an interest as would entitle them to bring a bill to restrain such action.

"I therefore recommend that the bill be dismissed without prejudice to the right of the complainants to institute suit to prevent a diversion of water from Lake Michigan in case such diversion is made or attempted without authority of law."

The Supreme Court of the United States has so far failed to take any public action with regard to the report of its Special Master. If the court sustains the decision of Judge Hughes the diversion may be continued as long as the same is authorized, whether by direct Congressional action or by permit from the Secretary of War.

It seems reasonable to conclude that if the Illinois Waterway is promptly completed and water-borne commerce becomes thoroughly established, a sufficient diversion may be continued to provide for the needs of navigation.

ILLINOIS VALLEY FLOOD CONTROL COMMISSION.

The Fifty-fifth General Assembly provided for the creation of the Illinois Valley Flood Control Commission "for the purpose of studying the causes of floods, conferring and cooperating with other bodies or agencies and providing means for flood control in the Illinois River Valley."

Under the terms of this Act, the writer and Stillman J. Stanard, Director of Agriculture, are, *ex officio,* members of said commission. The members appointed by the Governor are:

Senator Andrew S. Cuthbertson, of Bunker Hill, Chairman;
Representative H. V. Teel, of Rushville, and
Archie T. Dunn, of Beardstown, Secretary, a "citizen residing in the Illinois Valley region."

The first meeting of this Commission was held at Springfield, December 21, 1927, at which time the writer presented maps and profiles and reports from the Division of Waterways, together with records showing the general condition of the Illinois River Valley and descriptions of the recent floods therein which led to the creation of the Commission by the action of the General Assembly.

The engineers of the Division of Waterways have from time to time furnished to the Commission information on engineering features of the Illinois Valley particularly from the matter being prepared for a special report of the Division regarding flood control, which is to be published as soon as completed.

THE DIVISION AND THE DENISON-DENEEN BILL.

In response to a letter from Hon. Charles S. Deneen, United States Senator from Illinois, dated January 30, 1928, asking for data regarding the Illinois section of the Lakes-to-Gulf-Deep-Waterway; the importance of extending the Federal Barge Line service to the Illinois River and the Hennepin Canal (Illinois and Mississippi); and damage by floods to the lands of our State in the Mississippi, Illinois and Ohio River bottoms, this office, under date of February 6, 1928, furnished the Senator a manuscript copy of a report by the Supervisor regarding "Floods in Illinois," filed November 7, 1927, by Governor Len Small, with the Flood Control Committee of the House of Representatives of the Congress of the United States. At the same time there was submitted a copy of Governor Small's address before the committee, and copies of engineering suggestions by Mr. M. G. Barnes, then Chief Engineer, and by Mr. L. D. Cornish, Assistant Chief Engineer, who was in charge of emergency flood relief work for the State, under Senate Bill 576 of the Illinois General Assembly. The data referred to are included in this report at pages 26 to 40 inclusive.

BRENT'S REPORT IN AID OF THE AMENDMENT.

Under date of February 25, 1928, there was furnished to Senator C. S. Deneen an original manuscript copy of a special report regarding extension of the Federal Barge Line service to the Illinois River and Hennepin Canal as proposed in a bill introduced in the United States Senate by Senator Deneen.

This report, prepared by Mr. Theodore Brent, former traffic manager of the Federal Barge Line, and now engaged as transportation expert and terminal consultant for the Division of Waterways, was substantially as follows:

MEMORANDUM CONCERNING EXTENSION OF SERVICE OF THE FEDERAL BARGE LINE TO THE ILLINOIS RIVER AND HENNEPIN CANAL, AS PROPOSED IN BILL INTRODUCED BY SENATOR CHARLES S. DENEEN.

Prepared for the Use of
HONORABLE WM. F. MULVIHILL, SUPERVISOR
ILLINOIS WATERWAY CONSTRUCTION.

By THEODORE BRENT.

February 23, 1928.

The proposal, embodied in the bill introduced in the Senate by Senator Charles S. Deneen, is to direct the Secretary of War to extend the government service of common carriage now being operated on the Mississippi River to include the Illinois River and the Hennepin Canal.

There is appended to this report, as *Exhibit A*, a map showing the extent of existing services of the Federal Barge Line on the Mississippi River. Included in this exhibit is a forecast of the proposed service on the Illinois River and Hennepin Canal as it will doubtless work out in practice.

THE ILLINOIS RIVER.

This stream is now commercially navigable for craft drawing seven feet of water from its point of junction with the Mississippi River, near Grafton, to Utica, Illinois, a distance of 224 miles.

Before the introduction into this stream of the 8,500 cubic second feet of water from Lake Michigan which it now receives through the Chicago Drainage Canal and the DesPlaines River, the navigable depth required for craft of that earlier time was secured by the introduction of four locks and dams. Of these the State of Illinois built two, one at Henry and the other at Copperas Creek. Later the Federal government built two dams with larger locks below Peoria, one at Kampsville and the other at LaGrange.

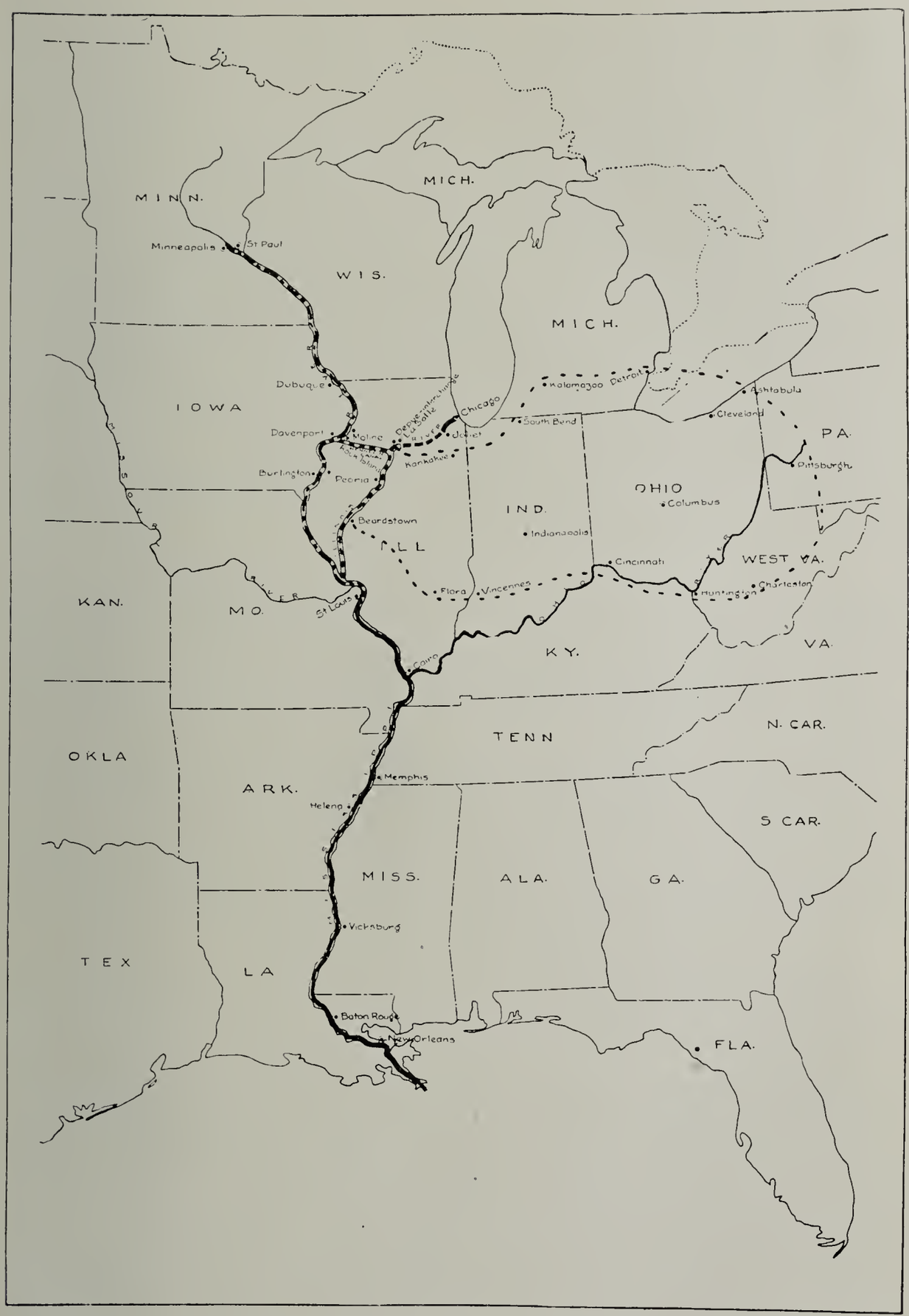
Under present circumstances the required depth to float barges drawing seven feet of water can be secured with free flow of the existing minimum run-off above Peoria. Consequently the State has ceded to the Federal government the sites of the Henry and Copperas Creek dams. These two impediments will be partially destroyed this season by the United States Engineers, so as to admit of free passage around the small State locks.

The two Federal locks at Kampsville and LaGrange are, under the present engineering plan, to be retained until the nine foot project is fully out.

The five new locks of the Illinois Waterway are being built to the standard dimensions for all government projects of nine foot depth, namely 110 by 600 feet. The dimensions of the Federal locks at Kampsville and LaGrange are but 75 by 350 feet. While this limitation of dimensions forms an impediment to the working out of the great standardized scheme for the Mississippi Water Trunk Line and the cost and inconvenience of operation will unquestionably become serious when navigation takes on large proportions, these two locks do not constitute an insuperable obstacle to the immediate extension of the existing services of the Federal Barge Line to include this stream.

THE HENNEPIN CANAL.

This is a Federal project completed some forty years ago. It forms a short water transportation link between the Illinois and Mississippi Rivers. Forming a junction with the Illinois River at the point where that stream, after having traversed half the width of the State in a generally westerly direction from Chicago, turns sharply south, this canal pursues a course due west on nearly an air line to a connection with the Mississippi River at the



"Exhibit A," showing extent of "lower" and "upper" river services of the Federal Barge line on the Mississippi River. The dotted line shows feasible extension of lower river services.

mouth of the Rock River, just south of Rock Island. With the unfinished Illinois Waterway, this provides a water link between Chicago and the upper Mississippi River only 186 miles long, as contrasted with the Rock Island railroad between the same points of 181 miles, and the short line rail distance of the Northwestern railroad of 138 miles between Chicago and the Mississippi River at Clinton, Iowa.

Exhibit B is a map and profile of the Hennepin Canal.

Leaving the level of the Illinois River at Bureau, the canal rises rapidly to the level of the high tableland which constitutes the area of the State between the Illinois and Rock River Valleys. In the first twenty miles there are 21 locks which lift the barges to a height of 199 feet above the level of the Illinois. From this point to the junction with Rock River at Lock 29—62 miles from Bureau—there are long stretches of pool water through which barges can move rapidly and steadily. From Lock 29 on to the junction with the Mississippi just below Rock Island, a distance of 75 miles from Bureau, the canal either merges with or is carried beside Rock River. There is a total descent of 93 feet from the summit to the level of the Mississippi. There are 31 locks in all. They have 35 x 170 feet clearance, with a navigable depth of 7 feet over the mitre-sills at standard stage. stage. Bridges have 17 feet clearance above the water at standard stage.

It will take about eighteen hours to move barges through the Hennepin Canal between Bureau and Rock Island.

OPERATION.

In the map constituting Exhibit A, the operation designated as the Lower Mississippi River Section is shown in solid black and that of the Upper River Section in parallel lines. A dotted line has been included to indicate the feasible extension of the Lower River service beyond St. Louis up the Illinois to Peoria. Likewise the operation of the Upper River Section has been extended through the Hennepin Canal and down the Illinois to Peoria, as indicated.

Peoria, as the largest city and the greatest point of interchange with the railroads upon the Illinois River, is the most logical point of beginning and termination of the two services. For the purpose of serving its existing traffic, if the Lower River service is to be extended to some point farther north than St. Louis, it must come to Peoria. For like reasons, the Upper River service must have access to the railroad interchange at Peoria, if its service is to be extended east of Rock Island through the Hennepin Canal.

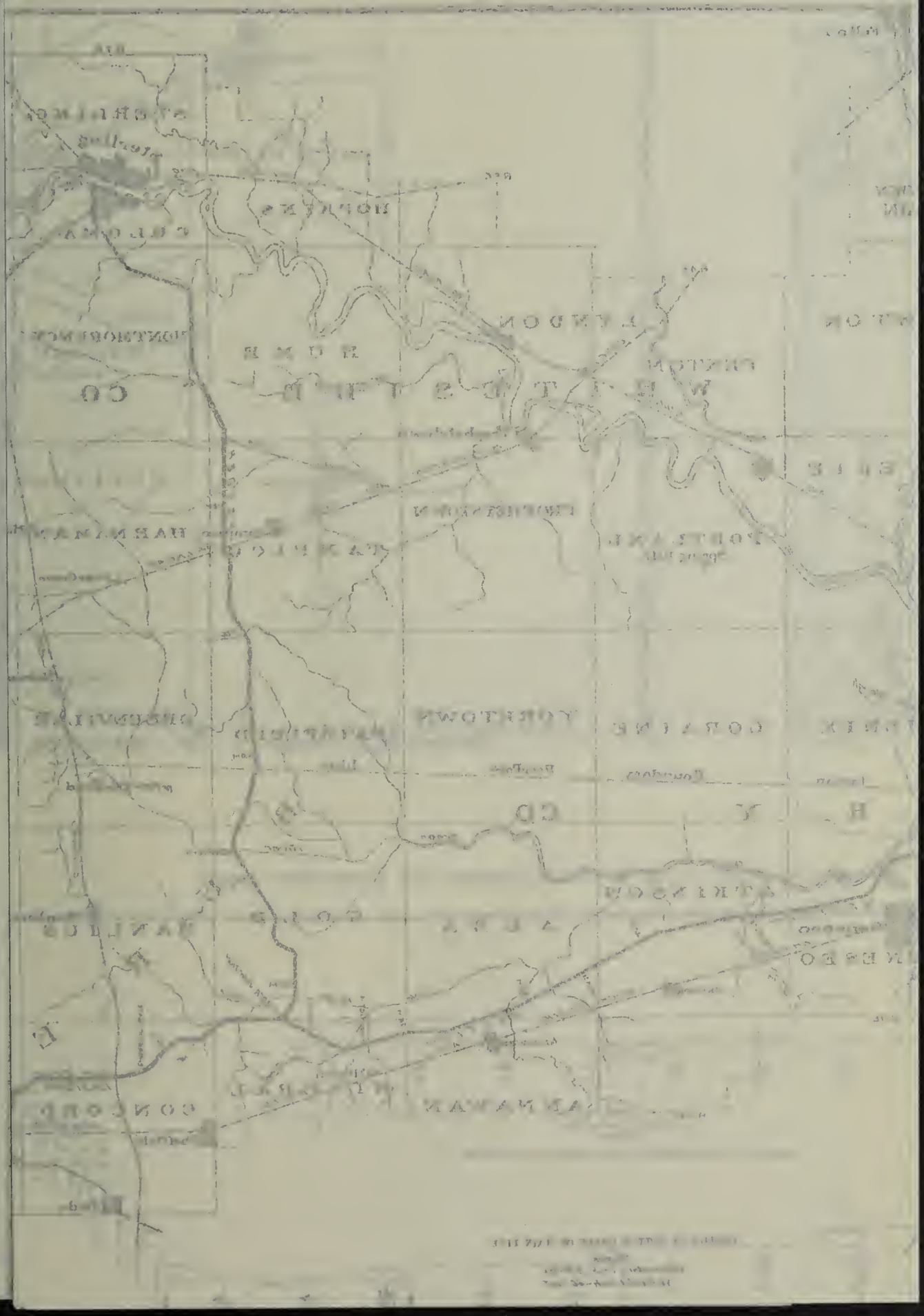
LOWER RIVER BARGES CARRY 2,000 TONS.

The standard barges of the Lower River service are 45 by 230 feet and carry 2,000 tons deadweight on eight feet draft. These barges can be profitably operated up the Illinois to Peoria or LaSalle. They cannot go through the Hennepin Canal.

The standard barges of the Upper Mississippi River Section are 33 by 130 feet and will carry 500 tons on 6 feet draft. These barges were especially designed of dimensions permitting their passage through the Hennepin Canal.

In the Mississippi River below Cairo the Federal Barge Line moves with standard tows of six 2,000-ton barges. The power boats of the line draw 8 feet and are very successful in that reach of the river. The line has no power boats suitable for the river between Cairo and St. Louis. Service between these two terminals has never been what it should be and the costs of operation in that reach of the river have been inordinate by reason of lack of proper power boats. Additional power boats would have to be built to serve on the Illinois River. They should be of substantially 1,500 indicated horsepower, built to dimensions which will carry economical propelling machinery of this power on not in excess of 6 feet draft.

These tow boats could successfully move tows of three of the standard 45 by 230 foot barges in regular schedules between St. Louis and Peoria, interchanging the barges at the former point with the towboats of the Lower Mississippi River Section.



STATE OF ILLINOIS
DEPARTMENT OF PURCHASES AND CONSTRUCTION
DIVISION OF WATERWAYS

COPIED FROM MAP DRAWN UNDER DIRECTION OF MAJOR C.S. RICHE CORPS OF ENGINEERS U.S.A. PUBLISHED FOR THE BENEFIT OF OWNERS AND NAVIGATORS OF COMMERCIAL AND PLEASURE CRAFT IN ILLINOIS BY THE RIVERS AND LAKES COMMISSION

SCALE

NOTES.

Normal dimensions of Canal and Feeder are 50 ft. width at water surface, 52 ft. width at bottom and 7 ft. depth.
Increased widths are provided in a number of places where the canal is in embankment.
Locks are 170 ft. long between gates, 35 ft. wide with 7 ft. depth over sills at standard stage. Bridges on main line have 17 ft. clearance above standard stage. Those on feeder have 12 ft.
Telephone wires etc. have clearance of 17 ft. on main line and 22 ft. on feeder.
The grades shown hereon refer to Hennepin Datum

Comparative Elevations

Mean Sea Level	0.000 ft.
Hennepin Datum (Illin. Riv. Connection)	+ 428.073 "
Memphis Datum	- 6.775 "
Cairo "	- 19.000 "
St. Louis Directrix	+ 413.989 "
Chicago City "	- 579.083 "

Note: Hennepin Datum, Ill. Riv. Connection = 429.580 "

ROCK RIVER POOL

SCALE OF MILES

PROFILE OF BOTTOM GRADE OF MAIN LINE

Scales
Horizontal: 1 Inch = 3 Miles
Vertical: 1 Inch = 40 Feet

PROFILE OF BOTTOM GRADE AND WATER SURFACE OF FEEDER

Scales
Horizontal 1 Inch = 3 Miles
Vertical 1 Inch = 40 Feet

STATE WATER SURVEY DIV. Library Cor

UPPER RIVER SECTION.

The barges of the Upper River Section would have to move in single formation through the Hennepin Canal to a mooring at its junction with the Illinois River at Bureau. One of these loaded barges can easily be pushed through the canal by a gasoline launch manned by not in excess of three men. Launches would have to be provided of dimensions which would permit the launch and a single barge to be accommodated at one lockage. With thirty-one locks to be negotiated, this would be the only feasible method of operation.

Service in the 60-mile reach of the river, between Peoria and LaSalle could probably best be handled by a towboat of the Illinois River type which could take both Upper and Lower River barges to local terminals at Peru and LaSalle, and to a possible interchange with the C., M., St. P. & P. and New York Central Railroads in the vicinity of DePue. This boat could also move the Upper River barges between the terminus at Peoria and the Canal, mooring near Bureau. This power boat would be necessary owing to the fact that gasoline launches which would successfully push loaded barges through the slack waters of the Hennepin Canal could not make headway against the current of the Illinois River.

TRAFFIC—LOWER MISSISSIPPI SECTION.

Peoria, LaSalle and Peru are the principal manufacturing and distributing cities on the portion of the Illinois River which is presently navigable. These cities are today shipping much of their traffic by way of the Federal Barge Line through St. Louis and Cairo into the Lower Mississippi Valley, the Southwest and the Pacific Coast, together with their exports. The three cities mentioned ship all kinds of steel products, zinc and lead products, binder twine, implements, alcohol, glucose and corn products. The waterborne tonnage would be greatly increased were there direct barge service from them in place of rail-and-water service such as there is today.

On traffic moving from Peoria at present to the states of Arkansas and Oklahoma, the Lower Mississippi Section receives the freight from the railroads at St. Louis and re-delivers it to its rail connections at Memphis. We list below the savings which accrue to Peoria shippers or their consignees on this present traffic, and the increased savings which will accrue when there is direct water service from Peoria, LaSalle and Peru.

SAVINGS TO PEORIA WATER SHIPPERS.

	Iron and steel products.	Pig lead and zinc.	Binder twine.	Implements.	Alcohol.	Glucose.	Cereal products.
Present differentials (in cents per 100 pounds)	4.5	6	10.5	9	7.5	5	6c
Savings with through service from Illinois River	7.5	7.5	12.	12	14.5	7.5	7c
Increased saving to public	3 (Or 60c per ton.)	1.5 (Or 30c per ton.)	1.5 (Or 30c per ton.)	3 (Or 60c per ton.)	7 (Or $1.40 per ton.)	2.5 (Or 50c per ton.)	1c (Or 20c per ton.)

This would mean, for example, that on each car of steel products shipped from or through Peoria to Memphis or through Memphis into Arkansas or Oklahoma there would be an additional saving to the public of $25.00 per car by reason of the extension of the barge service up the Illinois to the present head of navigation.

There is today rail-barge-and-rail service from Peoria, by rail to St. Louis, barge to Vicksburg, and thence by rail into northern Louisiana and Texas. Immediately below we list present and approximate new differentials on this traffic from Peoria, LaSalle and Peru, together with the increased saving to the public immediately resulting from the extension of the Lower River service up the Illinois.

INCREASED BENEFITS OF EXTENSION OF SERVICE.

	Iron and steel products.	Pig lead and zinc.	Binder twine.	Imple-ments.	Alcohol.	Glucose.	Cereal products.
Present differentials (in cents per 100 pounds)	6	7.5	13.5	11.5	15	6.5	7.5
Savings with through service from Illinois River	9	9	14	15	18.5	9	9
Increased saving to public	3 (Or 60c per ton.)	1.5 (Or 30c per ton.)	.5 (Or 10c per ton.)	3.5 (Or 70c per ton.)	2.5 (Or 50c per ton.)	2.5 (Or 50c per ton.)	1.5 (Or 30c per ton.)

Through New Orleans there are rail connections into all south Louisiana and Texas; there are steamship connections to Mobile and Pensacola and to the entire Pacific Coast. There are also regular steamship lines taking the exports of the country to all sections of the world.

The present and prospective differentials and the increased savings to Illinois industries on traffic to and through New Orleans resulting from the proposed extension of service up the Illinois are shown below.

PRESENT AND PROSPECTIVE DIFFERENTIALS.

	Iron and steel products.	Pig lead and zinc.	Binder twine.	Imple-ments.	Alcohol.	Glucose.	Cereal products.
Present differentials	5.5	8	14.5	12.5	17	7	9
Savings with through service from Illinois River	10.5	9.5	16.5	17	17.5	10	10
Increased saving to public	5 (Or $1.00 per ton.)	1.5 (Or 30c per ton.)	2 (Or 40c per ton.)	4.5 (Or 90c per ton.)	.5 (Or 10c per ton.)	3 (Or 60c per ton.)	1 (Or 20c per ton.)

MATERIAL SAVINGS TO ILLINOIS INDUSTRY.

The extension of the service consequently offers to Illinois industries on their manufactured products additional savings ranging from 10 cents to $1.40 per ton. The opportunity which these savings, coupled with the advantage of direct water service, offer to the merchants of these cities as a means of expanding their markets in the whole South and Southwest and upon the Pacific Coast is very great.

The Southwest is already a great distributing market for Illinois industries. In that territory many of the savings can be converted directly into profits. In the export and Pacific Coast trade the Atlantic seaboard today has marked advantages in all-water rates. Every cent saved to Illinois manufacturers in freight costs to these highly competitive markets gives an added opportunity for profitable distribution and in many instances makes possible entrance into valuable competitive fields of distribution which are today closed to them by high freight costs.

Chicago, Rockford, Freeport, Joliet, Aurora, Elgin and all the other manufacturing cities and towns of northern Illinois would, through the system of joint rates already approved, be accorded the same savings as above listed from Peoria when the service of the Federal Barge Line can be extended up the Illinois so that the joint rates now effective through St. Louis may be established through Peoria and reflect the additional savings accruing through this 200 miles of additional water haul. The traffic affected and which can be attracted by these additional aids to distribution amounts to hundreds of thousands of tons annually.

MANUFACTURERS AND MERCHANTS HELPED.

The merchants of this same territory sell and distribute large quantities of southern products such as sugar, rice and molasses. They import much coffee and sisal. They buy large quantities of canned fruits from California, pineapple from Hawaii, salmon from the North Pacific Coast. All these commodities are brought by water to New Orleans and thence inward by barge. The added differentials accruing to the public on these commodities when distributed through Peoria by reason of the added water haul above St. Louis will range from 20 to 25 cents per ton.

In 1927 the merchants of Illinois and Wisconsin distributed approximately 5,000 carloads of sugar which moved north by barge into northern Illinois, Wisconsin, Minnesota, Michigan and northern Iowa, which will distribute naturally through Peoria when the service is extended up the Illinois.

LARGE VOLUME OF TRAFFIC.

This traffic amounted to approximately 150,000 tons and the saving to the public from the longer water haul to Peoria will be not less than $30,000.00 on this item alone.

The yearly importation of coffee through New Orleans is in excess of 2,500,000 bags. At least one-third of this traffic moves to territory which, if shipped by barge, will distribute naturally through Peoria.

Of the annual importation of some 250,000 bales of sisal, the major portion is consumed at Chicago, Peoria, St. Paul, Stillwater, Waupun, Wis., and Jackson, Mich. All of this traffic will seek water transportation if barges are provided and all of it will move through Peoria, except that for St. Paul and Stillwater, which latter traffic will move by water all the way.

UPPER MISSISSIPPI RIVER SECTION.

Peoria today can only reach the Twin Cities of Minneapolis and St. Paul through the Upper River by way of the rail lines through Dubuque. Peoria merchants and manufacturers, as well as all of the Illinois industrial area which would reach the river through that port, do a very large business with the dealers and distributors of the Twin Cities. The jobbing houses and brokers of St. Paul and Minneapolis control the bulk of the trade of the states of Minnesota, the Dakotas and Montana. They buy in carloads from Illinois and the Lake States, for which Peoria is the gateway, much of the merchandise which they job in the Northwest.

The present comparison of class rates from Peoria to the Twin Cities is:

Classes.	1	2	3	4	5	A	B	C	D	E
All-rail	98	83.5	68.5	49	34.5	39	32	27.5	22	19.5
Rail and barge through Dubuque	84.5	72	59	42.5	30	33.5	27.5	24	20	------
Barge saving	13.5	11.5	9.5	6.5	4.5	5.5	4.5	3.5	2	------

A UNIFORM DIFFERENTIAL OF 20 PER CENT.

The Commission, on account of some glaring inconsistencies in the railroad rate adjustments, only required the railroads to join the Upper River Section in through rates via Dubuque carrying a differential of 15 per cent under the all-rail figures. The uniform differential through all Lower River ports is 20 per cent, and that is the basis the Barge Line desired to establish.

With an all-water service between Peoria and the Twin Cities the differential will unquestionably be made 20 per cent, as that is the basis used between all the cities on the Upper River which now have the benefit of all-water service.

Such relief will be timely and greatly appreciated by all Illinois merchants and manufacturers. The railroads in cases now pending before the Commission are asking very marked increases in their class rates. Presuming that they are granted, and the Upper River Section is permitted to extend its service through to Peoria, the comparison will be as follows:

Classes.	1	2	3	4	5	A	B	C	D	E
Proposed all-rail	135	115	95	81	54	61	47	41	34	23
All-water	108	92	76	65	43	49	38	33	27	18
Water differentials	27	23	19	16	11	12	9	8	7	5
Present rail and water differentials	13.5	11.5	9.5	6.5	4.5	5.5	4.5	5.5	2.5	0
Increased saving by extension to Peoria	13.5	11.5	9.5	9.5	6.5	6.5	4.5	4.5	4.5	5

EXTENSION OF SERVICE WILL DOUBLE DIFFERENTIALS.

In other words, the extension of Upper River service through the Hennepin Canal will enable existing differentials under proposed higher rail rates, to be doubled or more than doubled.

As explained in the case of the Lower River Line, these savings will not be confined to the cities on the bank of the Illinois River, but will be reflected in the through rates which will be constructed with diverging railroads under opinions already rendered by the Interstate Commerce Commission and upon which a very large basis of joint rates is already established.

Upon the map which constitutes Exhibit A there is a line drawn from DePue and Beardstown, Ill., on the Illinois River and encircling a large portion of Illinois and Indiana, all of Ohio and portions of southern Michigan, western Pennsylvania and West Virginia. This constitutes the bulk of what in railroad parlance is known as Central Freight Association Territory.

JOINT RAIL AND WATER RATES.

The railroads which dominate this large area have their principal Western termini at Chicago, Peoria and St. Louis. They none of them touch the Mississippi River at any point north of St. Louis. They all of them touch the Illinois River at Peoria, DePue and Beardstown.

By reason of this geographical situation there are no joint rates today from this productive territory to the Twin Cities of Minneapolis and St. Paul in connection with the Upper Mississippi River Barge Line, except from points on the Illinois Central Railroad. It will never be possible to establish such rates through St. Louis from the major portion of this territory, for this would require the carrying of the business by long routes both by rail and water around two sides of a triangle and the rule of circuity established by the Commission prohibits it.

The same rule invoked in connection with the Upper River service extended through the Hennepin Canal to DePue, Peoria and Beardstown would permit the establishment of a full line of rates on all classes and commodities to St. Paul and Minneapolis.

This area manufactures a very large portion of the traffic which is consumed and distributed at the Twin Cities. From this area and from the Chicago District (which already has joint rail and barge rates through Dubuque) there is received every day at the Twin Cities in package cars 150,000 pounds of less carload merchandise. The bulk of merchandise is rates first, second and third class. The public saving on this class of merchandise moved all-water from Peoria to the Twin Cities can be conservatively placed at 20 cents per 100 pounds or $4.00 per ton.

POSSIBLE SAVINGS ON COMMODITIES LISTED.

We list below the tonnages of a number of important groups of commodities received in the Twin Cities in the calendar year 1927. The traffic largely originated in the Central Freight Association Territory and the Chicago District. The savings afforded by the joint rates through Illinois River gateways, as here listed, would naturally deflect a very substantial share of this tonnage to the rail and water routes.

	Tons.	Anticipated savings per ton.
Agricultural implements, vehicles	90,303	1.35
Automobiles and trucks	79,543	1.75
Furniture	21,930	1.75
Iron and steel products	433,559	1.00
Machinery, boilers	35,351	1.10
Miscellaneous	678,200	1.50

In the reverse direction, the Upper Mississippi Section would bring to Peoria principally flour. There is annually ground at Minneapolis and distributed into the Central Freight Territory, in excess of 4,000,000 barrels of flour of an average weight of 200 pounds. The proportional rail rate on flour from the Twin Cities to Peoria is 13 cents per 100 pounds. The water line would be authorized under the standard 80 per cent basis to carry an all-water rate of 10 cents per 100 pounds, and could afford to do so. This would be a saving to the public of 6 cents per barrel. If the whole movement came down by water, this would offer an annual public saving on this commodity alone of $240,000.

EXTENSION OF THE SERVICE—FACILITIES LACKING.

All the authorized capital of the Inland Waterways Corporation is expended or under contract. The corporation has not today nearly enough facilities and equipment to provide the needed transportation on the Upper or Lower Mississippi or the Warrior River.

The power boats are unsuited to this service. There are no barges to spare. The death of equipment and facilities and the unsatisfactory conditions resulting from existing lack of capital are very clearly set out in a statement presented last October to the Secretary of War by the Barge Line Users Special Committee. On this subject the committee said, in part:

"The line is, therefore, not, in any sense, serving the public as Congress intended it should, but is of special and doubtful benefit only to those who may be contented with the allocation of limited space and uncertain schedules. The management has thus been forced to discriminate against shippers to the extent of forcing certain commodities off the line entirely. These deficiencies in equipment and service have been allowed to accumulate for years, and must inevitably, unless promptly remedied, defeat the very object of Congress in the establishment of this transportation system."

REQUIRED ADDITIONAL GOVERNMENT INVESTMENT.

A Congressional direction to the Secretary of War to extend the service of the Federal Barge Line to the Illinois River and the Hennepin Canal implies and requires a Congressional authority to increase the existing capital stock of the Inland Waterways Corporation sufficiently to permit of the expenditure necessary to put the Congressional mandate into operation. It also requires the actual sale to the Federal Government of this additional capital stock and an appropriation sufficient to buy it at par.

The present capital of $5,000,000.00 is of little significance. The corporation is the repository of some $20,000,000.00 of Government property dedicated by Congressional enactment to the operation and development of common carrier services. These services Congress has directed the Secretary of War to continue "to the point where they may be disposed of to private capital to the best advantage of the Government."

ADDITIONAL EQUIPMENT REQUIRED.

In order to form simply the beginning of a service which will do no more than provide an extension to Peoria of the services of the Upper and Lower Mississippi Sections so as to syncronize with existing services on those streams there will be required:

For Lower River Section:	
Three towboats, $250,000 each	$ 750,000.00
Twenty barges, $70,000 each	1,400,000.00
For Upper River Section:	
Twenty barges, $20,000 each	400,000.00
Five power launches, $3,000 each	15,000.00
Moorings at Bureau and Rock Island	20,000.00
Total	$2,585,000.00

This takes no account of the matter of terminals, presupposing that these will be provided by the communities. This, it is hoped, will be realized at Peoria. However, needed interchanges with vital rail connections at Beardstown and DePue are not here provided for and there is little probability that these communities will be able to provide them. The actual capital appropriation for this extension of service would more wisely be rounded out to $3,000,000.00, so as to allow a safe margin either for direct construction of these interchanges by the corporation or for loans to these communities for such construction, as authorized by section 201 of the Transportation Act of 1920.

CONGRESS VOTES ADDITIONAL CAPITAL.

Congress not only authorized the Secretary of War to extend the Federal Barge Line service, but also voted to increase the capital stock of the Inland Waterways Corporation, which operates the barge line, from $5,000,000 to $15,000,000, in order to permit the program for the extension to be speedily carried out.

CHIEF ENGINEER BARNES RESIGNS.

Because of his continued ill-health, Mr. Mortimer G. Barnes, Chief Engineer of the Division since November 1, 1917, found it necessary to ask to be relieved of the duties and responsibilities of that position, effective May 1, 1928.

Although physically unable to meet the exacting demands of the work as Chief Engineer, Mr. Barnes felt himself able to continue in the service of the Division in a consulting capacity and a mutually satisfactory and advantageous arrangement was made accordingly.

Following Mr. Barnes' resignation Mr. Lorenzo D. Cornish, Assistant Chief Engineer of the Division since 1920, was promoted to the position of Chief Engineer, for which he is admirably equipped by education and experience. Mr. Walter M. Smith, Sr., for many years Chief Designing Engineer, was made Assistant Chief Engineer.

THE QUALIFICATIONS OF MR. CORNISH.

Mr. L. D. Cornish, the new Chief Engineer, graduated June, 1902, from Syracuse University with the degree of C. E. His titles, occupations, engagements have been as follows:

From June, 1899, to September, 1902, general engineering work on the design and construction of sewage and water supply systems and the location and construction of railroads. Instrument man.

From September, 1902, to September, 1906, Pittsburg and vicinity—U. S. Jr. Civ. Engr. and Supt. of Construction—Design and construction of locks and dams on the Ohio River.

From October, 1905, to February, 1909, Assistant Engr., Washington, D. C.—Assisting The International Consulting Board on designs and estimates for various proposed plans for Panama Canal.

From September, 1906, to June, 1907, Assistant Engineer, Isthmian Canal Commission, Washington, D. C.—Designs for Panama Canal Locks and Dams.

From June, 1907, to August, 1913, Panama Canal Zone—Designing Engineer, Isthmian Canal Commission, in charge of the design and the inspection of construction of all Panama Canal Locks exclusive of miter gates, machinery and protective devices, also consulting and reviewing engineer for the design of these excluded items.

From June, 1914, to November, 1914, Shanghai, China and vicinity—Principal Asst. Engr. to the American National Red Cross Board of Engineers appointed to investigate and report upon the Huai River Conservancy Project in China—In charge of field work, estimates, etc.

From March, 1915, to June, 1917, Cincinnati, Ohio—Prin. U. S. Asst. Engr.—Central Division, U. S. Engr. Dept. Designs and Inspection for the Division Engr. of improvements on the Ohio River and its tributaries.

From June, 1917, to November, 1919, Capt. and Major of Engrs. U. S. A. in charge of construction work in France for two years and on railroad organization work in the U. S. from July to November, 1919.

From November, 1919, to June, 1920, Designing Engineer—Division of Waterways, State of Illinois.

From June, 1920, to May, 1928, Asst. Chief Engr.—Division of Waterways, Dept. Purchases and Construction, State of Illinois—Designs, Plans and Construction of The Illinois Waterway to connect the Great Lakes with the Mississippi River.

From June, 1927, to May, 1928, Acting Chief Engr.—Acting Chief Engr., Illinois Division of Waterways in charge of levee construction in Illinois on Mississippi River, and rivers of Illinois.

May, 1928, Chief Engineer, Division of Waterways, State of Illinois. In engineering charge of location, design and construction of navigable waterways, levees, flood control projects, etc., within and for the State of Illinois, including The Illinois Waterway link of Lakes-to-Gulf-Waterway.

ENGINEERING REPORT.

By L. D. Cornish, *Chief Engineer.*

The fiscal year, 1927-28, is conspicuous for the marked increase in the activities of the engineering department. Flood relief acts passed on the closing day of June necessitated the immediate creation of a new organization to carry on the work provided for, which contemplated the expenditure for Flood Relief only, of approximately $1,896,000, an amount greater than the expenditure for all purposes of the entire Division of Waterways for any preceding fiscal year. Then, in January, 1928, the dynamic urge for action of the Supervisor of Illinois Waterway Construction expressed itself in his announcement of April 1, 1931, as the schedule date for completion of The Illinois Waterway. This necessitated an immediate increase in the designing force, in order that plans and specifications might be rushed to completion, so that new work could be advertised and contracts awarded as rapidly as possible. This added activity is indicated by the increase in the designing division. Eight men, during the preceding year, performed 2,630 man days of work for an aggregate salary of $2,000 per month, whereas, at the close of this year this force had been augmented to 17 men at an aggregate salary of $4,600 per month, who accomplished 4,493 man days of work.

Also in order to promote a greater personal interest in their work and to increase their efficiency and knowledge of the requirements of design and construction by personal inspection of lock and dam structures in all stages of completion, all members of the designing force, accompanied by the Chief Designing Engineer, were directed to visit and inspect as soon as possible all construction jobs.

GREAT INCREASE IN VOLUME OF WORK.

The Chicago office started, during the fiscal year, the following construction:

Description—	Estimated cost.
Flood Relief (S. B. 576)	$ 912,313.23
Beardstown Levee and Sea Walls	396,000.00
Brandon Road Lock, Dam and Retaining Walls	4,100,000.00
Starved Rock Lock and Dam Metal Work	480,000.00
Cement for Brandon Road, etc.	950,000.00
Raising Valley Road near Ottawa	18,500.00
Aux Sable Aqueduct—I. & M. Canal	17,007.03
Gum Creek Culvert—I. & M. Canal	17,000.00
Painting LaSalle Aqueduct	3,909.41
Dredging at Spring Bay	2,857.92
Repairs to I. & M. Canal Banks	19,495.47
McHenry Dam—Fox River	4,803.55
Meyer's Bay Bridge, Fox Lake	14,168.00
Total	$6,936,054.61

This total of work placed under construction for this fiscal year, exceeds the total expenditures during the previous ten years of existence of the Division of Waterways.

DETAIL REPORTS ON SEVERAL PROJECTS.

The canvass of bids received for the Beardstown levees and sea walls appears on page 61, and for Contract No. 7, metal work for Starved Rock lock and dam, on page 76.

Plans and specifications were revised and completed ready for printing and advertisement for Contract 3, construction of Dresden Island lock and dam; No. 7 for Starved Rock metal work; No. 8 for machinery of all locks; No. 9 for Marseilles canal and dredging of Starved Rock, Marseilles and Dresden Island pools; No. 10 for all remaining lock gates and valves, Brandon Road and Dresden Island; and No. 11 for Brandon Road and Marseilles bridges; also three bridges in Joliet. A more extended discussion of designing activities is furnished in the report of Walter M. Smith, Chief Designing Engineer, on page 74.

The increase in field activities kept pace with the designing and administrative activities of the Chicago office, owing principally to the commencement, in November, 1927, of the construction of the Brandon Road Lock and Dam, Joliet retaining walls and the utilities tunnel, under the DesPlaines River, by the direct employment of labor, materials and equipment, and constructional direction by contract for personal services of superintendents. This work is by far the largest, most difficult and costly of any work on the Waterway, and constituted the principal work of the Joliet Division. A more extensive description of this, and the other work under his charge, may be found in the report of R. S. Heath, Division Engineer, on page 78.

Construction work in charge of the Ottawa office progressed at a very satisfactory rate during the fiscal year. On Contract No. 2, for the Starved Rock Lock and Dam, 49,000 cubic yards of concrete were placed in the lock in five working months, which constitutes a record for Illinois Waterway work.

Erection of the miter gates for the Starved Rock Lock under Contract No. 7, was started May 28, 1928, and the raising of the Valley Road west of Ottawa was completed during the year.

Several construction jobs, required for repair and maintenance of the Illinois and Michigan Canal, were completed under the engineering direction of the Ottawa office.

CONTRACT FOR BEARDSTOWN LEVEE AND SEA WALL—CANVASS OF BIDS RECEIVED MAY 25, 1927.

Item number.	Item.	Unit.	Quantities.	McWilliams Dredging Co., 1537 McCormick Bldg., Chicago, Ill.		James O. Heyworth, Inc., 606 So. Michigan Blvd., Chicago, Ill.		B. Layton, 213 Hershey Bank Bldg., Muscatine, Iowa.		Byrne Bros. Construction Co., Inc., 624 So. Michigan Blvd., Chicago, Ill.		States Corporation, 38 So. Dearborn St., Chicago, Ill.		Kochlitzky & Prosser Cape Girardeau, Mo.	
				Price.	Amount.	Price.	Amount.	Price.	Amount.	Price.	Amount.	Price.	Amount.	Price.	Amount.
A	Clearing for embankment	Lump sum	1	$4,000 00	$ 4,000 00	----------	No bid	----------	----------	$9,280 00	$ 9,280 00	$15,000 00	$ 15,000 00	$ 5,000 00	$ 5,000 00
B	Embankment	Cu. yd	450,000	2 6½	119,250 00	----------	No bid	----------	----------	25	112,500 00	24	108,000 00	32	144,000 00
C	Cofferdams, pumping, bailing, etc	Lump sum	--------	--------	----------	$22,500 00	$ 22,500 00	$37,500 00	$ 37,500 00	56,169 30	56,169 30	$7,900 00	87,900 00	10,000 00	10,000 00
D	Excavation for concrete walls	Cu. yd	11,000	--------	----------	1 00	11,000 00	2 00	22,000 00	67	7,370 00	2 00	22,000 00	1 00	11,000 00
E	Concrete	Cu. yd	10,000	--------	----------	10 00	100,000 00	10 25	102,500 00	10 32	103,200 00	12 90	129,000 00	21 00	210,000 00
F	Metal reinforcement	Pound	25,000	--------	----------	20	5,000 00	05	1,250 00	50½	1,375 00	05½	1,375 00	06	1,500 00
G	Foundation piles	Lineal ft	30,000	--------	----------	75	22,500 00	75	22,500 00	85	25,500 00	95	28,500 00	1 00	30,000 00
H*	Timber sheet piling	1,000 ft. B. M.	120M	100 0	12,000 00	----------	----------	----------	----------	110 65	13,278 00	125 00	15,000 00	100 00	12,000 00
I	Backfill	Cu. yd	22,000	--------	----------	60	13,200 00	50	11,000 00	28	6,160 00	1 00	22,000 00	80	17,600 00
J*	Stone paving	Sq. yd	1,000	3 0	3,000 00	----------	----------	----------	----------	3 00	3,000 00	2 00	2,000 00	3 00	3,000 00
K*	Vitrified pipe, 6 in. diameter	Lineal ft	1,000	5	500 00	----------	----------	----------	----------	1 00	1,000 00	50	500 00	20	200 00
	Total	----------	--------	--------	$138,750 00	----------	$174,200 00	----------	$196,750 00	----------	$338,832 30	----------	$431,275 00	----------	$444,300 00

* See footnote, page 12, of specifications.

Contracts were awarded to the McWilliams Dredging Co. and James O. Heyworth, Inc., as their combined bids, $312,950.00, was lowest for the entire work.

The work of the Ottawa office is quite fully covered in the report of Division Engineer, J. B. Bassett, on page 84 of this report.

STATE SUPERVISION OF STREAM POLLUTION.

In addition to its other duties, the Department of Purchases and Construction, Division of Waterways, has the responsibility of looking after the pollution of the streams and bodies of water in the State of Illinois. In connection with this work the Division has naturally accumulated considerable evidence to substantiate the desirability of, and the necessity for, State supervision of streams and lakes as they may be affected by polluting substances. To the average layman, however, unless he is personally affected by some serious case of pollution, the matter of State supervision of streams and lakes may seem an unnecessary and unwarranted undertaking at the tax payers' expense.

The writer, while in China on flood relief work, spent some four months on boats traversing the shallow lakes, canals and streams of East China between Shanghai and Pekin, and saw what is probably the world's worst case of stream pollution. The natural waters, while apparently clear, were so contaminated with disease germs that unless boiled or treated they could not be used by the white race for bathing or washing the inside of cabins. During the forty centuries of their historic existence the natives have become immune to disease from the external use of water, but even they, without exception, never use water as a beverage but always in the form of scalding hot tea.

Certain local conditions in Illinois are worse than the general conditions in China, and unceasing diligence on the part of all organized communities is necessary to improve local conditions and prevent the spread of contaminated water.

Considerable has been accomplished to date in this line of endeavor, even though at times corrective measures recommended and demanded have not been taken as rapidly as appeared desirable to the complainants. At best, even if the Department had the fullest legal powers to demand changes or entire new treatment works, the improvements would require considerable time. And naturally with the Departmental powers limited as at present, there are cases where undue delays, on the part of offending parties, occur. But our records indicate conclusively, that great progress has been made in clearing up the streams and bodies of water of the State. At present several of the larger cities which have not already done so, are providing sewage treatment plants. Several industries also, principally the gas plants, canning factories and milk plants are making necessary installations to reduce, if not fully remove, pollution. And with each new industry or community providing treatment for its wastes, it becomes less difficult to convince others of the necessity or desirability of doing likewise. It is hoped, therefore, that within a relatively few years the streams and bodies of water which have been grossly polluted will be greatly improved, and that those still in a satisfactory condition may remain so.

The elimination from the lakes and streams of Illinois of all preventable pollution is a problem of sanitation at the sources of the trouble, viz: Domestic sewage and industrial wastes, requiring for its solution

the services of experts in a highly specialized branch of engineering. The Division of Waterways has such a specialist on its engineering staff, in the person of Mr. M. C. Sjoblom, and his report on page 90 covers in more detail the problems encountered by the Division of Waterways in the control and elimination of the pollution of State waters.

EMERGENCY FLOOD RELIEF WORK.

It is unnecessary to describe in detail the causes leading up to the enactment of the Flood Relief Act of 1927. Such causes had their origin in the disastrous floods of 1926 and 1927, which are fully described in the Tenth Annual Report of the Division of Waterways. Suffice it to say, that an emergency existed which demanded and received prompt legislative action.

The Emergency Flood Relief Act, known as Senate Bill No. 576, is entitled, "An Act making an appropriation to furnish emergency relief in the areas in Illinois which have been inundated or damaged by floods and for the temporary repair and reinforcement of levees in such districts."

This Act, which was approved July 7, 1927, appropriated the sum of one million five hundred thousand ($1,500,000.00) dollars to the Department of Purchases and Construction for the biennium commencing July 1, 1927, for the purpose of furnishing necessary and proper relief as specified therein.

A complete copy of the Flood Relief Act is included in the Tenth Annual Report of the Division of Waterways; also there will be found therein a copy of the Attorney General's opinion as to the powers, duties and authority of the Director of the Department under this Act.

Summarizing the opinion rendered by the Attorney General, the work which the Department is able to do must be limited to the furnishing of emergency relief by making temporary repairs or furnishing temporary reinforcements for levees which have been or which are in danger of being damaged by flood waters, and the State cannot undertake the restoration of drains or reconditioning of soil nor the building of new levees except as necessary in the repair of those which have been damaged.

The opinion of the Attorney General also was that contracts could be let without the formality of advertising and asking for bids; that the work could be done by the employment of hired labor, the purchase of materials and supplies and the purchase or rental of necessary equipment, or for an agreed price, or on a cost plus basis. The latter opinion greatly expedited the work under the Act and made it of much greater value as an emergency relief measure, it being found possible in many cases to let contracts immediately where contractors and equipment were available without the loss of time required by asking for bids.

INVESTIGATION.

Before a force could be organized to carry on the work a general survey was necessary to ascertain the approximate quantity of work to be done and its probable cost. To this end a blank form for a "damage claim" was prepared and sent to all drainage districts, both public and

private, as well as all known individual owners of leveed land in flood areas. This form asked for information as to length of levee breaks, estimated yardage required and approximate cost of making repairs. Information was also requested as to the average crop yield and the financial condition of the District or owner. From these forms estimated damages were tabulated and classified as primary and secondary. The primary damage, which was considered to be of first importance in the program of levee reconstruction, consisted of work necessary to protect the land from overflow by ordinary floods. The secondary damage consisted principally of wave wash and repairs which were not of such immediate importance.

INSPECTION.

The writer, who had been placed as engineer in charge of the work, then proceeded to make an inspection of the flooded areas and to investigate as far as possible in the short time available the needs of each community or district.

Beginning July 1st and continuing until July 10th, the areas in the southern part of the State flooded by the Mississippi River were inspected. This trip included visits to Chester, Cora City, Gorham, Murphysboro, Carbondale, Anna, Cairo and Mounds City. At these points engineers and commissioners of the various drainage districts and other interested persons were interviewed and trips of inspection arranged for and made.

CAIRO AND MOUNDS CITY.

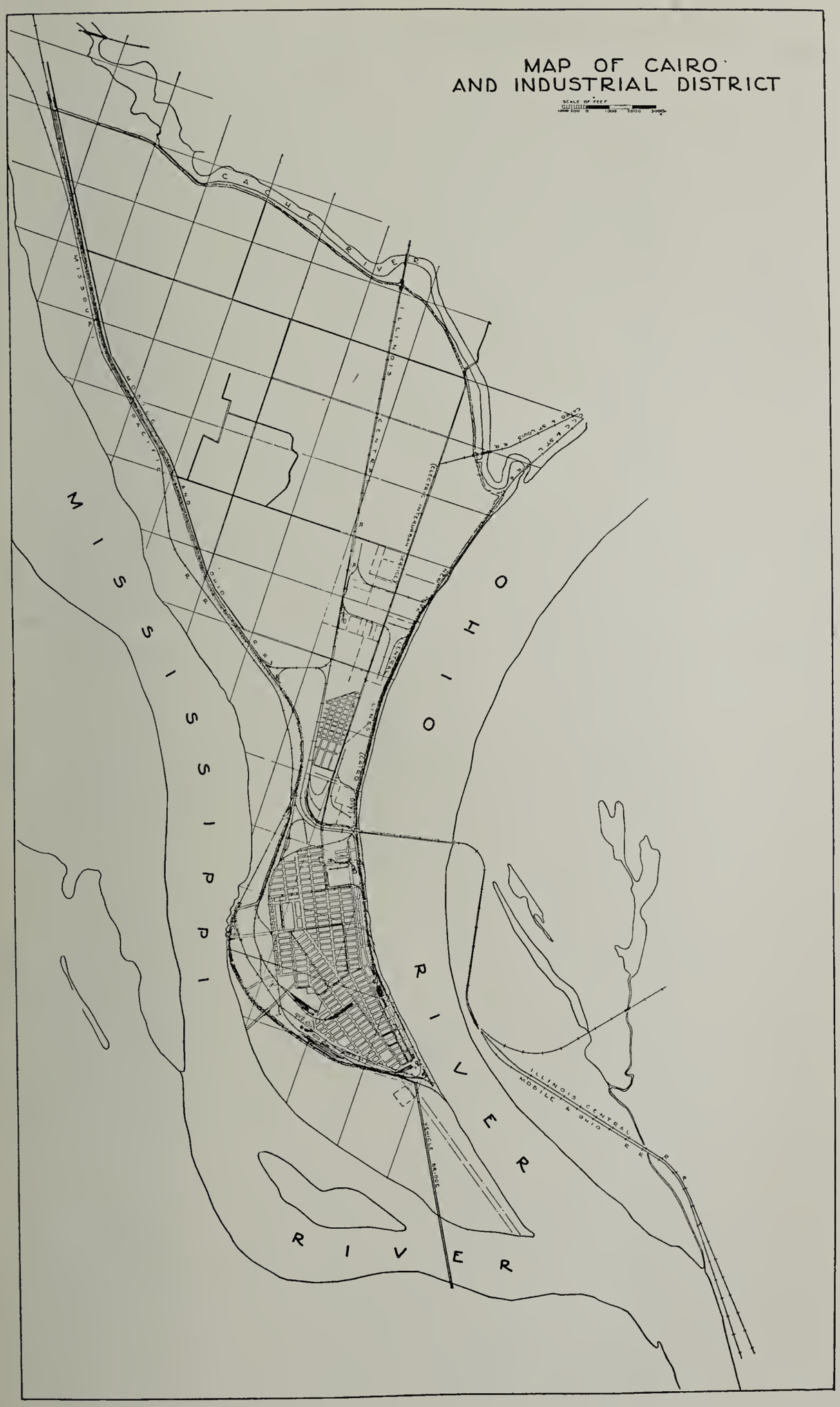
At Cairo and Mounds City, on account of the large city population subject to danger from the flood menace, a special effort was made to make a thorough inspection and to observe what aid the State could give to help remedy the dangerous situation then existing.

Due to the very efficient organization maintained by the local authorities at Cairo during the flood period, there had been no breaks in the levees, but there had been serious sand boils, bad wave wash and a sloughing off of the levees in many places. It was found also that there had been a great deal of damage and inconvenience caused by seepage and lack of sufficient interior drainage and that during flood periods the health of the inhabitants had been endangered by these conditions.

Large industries, upon which the prosperity of the city of Cairo depends, are located in the drainage districts immediately outside the city limits. Some of these industries were already considering the removal of their plants because of the flood menace. The interests of the city of Cairo and those of the drainage districts, therefore, were considered as one, consideration being given to the greatest needs of the area as a whole.

THE CACHE RIVER LEVEE.

The Cache River Levee of the Cairo Drainage and Levee District, protects one of the industrial districts of the city of Cairo and forms an added protection to the city itself. During the flood period there had been a continuous fight, demanding all available man power and


MAP OF CAIRO
AND INDUSTRIAL DISTRICT
CACHE RIVER
MISSISSIPPI RIVER
OHIO RIVER
ILLINOIS CENTRAL
MOBILE & OHIO R.R.
VEHICLE BRIDGE

the expenditure of $300,000, to keep this levee from breaking. The water had been as much as two feet above the top of this levee in places and had been kept out of the district only by the use of sand bags and the building of a timber bulkhead on top of the levee. The restoration of this levee was, therefore, considered of vital importance to the city of Cairo and vicinity.

The repair and strengthening of the Cache levee offers a striking example of the economy which, in general, characterized the flood relief work. The work, consisted of 474,431 cubic yards of earth, hauled on an industrial railroad an average distance of one and one-half miles and was placed on the levee and in banquettes for a contract price of 50 cents per cubic yard. This was at a cost of 4 cents per cubic yard less than the pre-war contract price for raising the same levee in 1914. The contractors made a small profit, in spite of numerous delays due to recurring flooding of the borrow pits.

HEARINGS BEFORE THE MISSISSIPPI RIVER COMMISSION.

On July 11th, Mr. William F. Mulvihill, Supervisor Illinois Waterway Construction, met the writer at St. Louis for the purpose of attending hearings before the Mississippi River Commission. Mr. Mulvihill orally presented the case of the State of Illinois and asked that due consideration be given to the needs of the flooded areas of the State in the allotment of any available funds. The reply to this plea was that such financial assistance as is called for by law would be given, but that all available funds were already pledged.

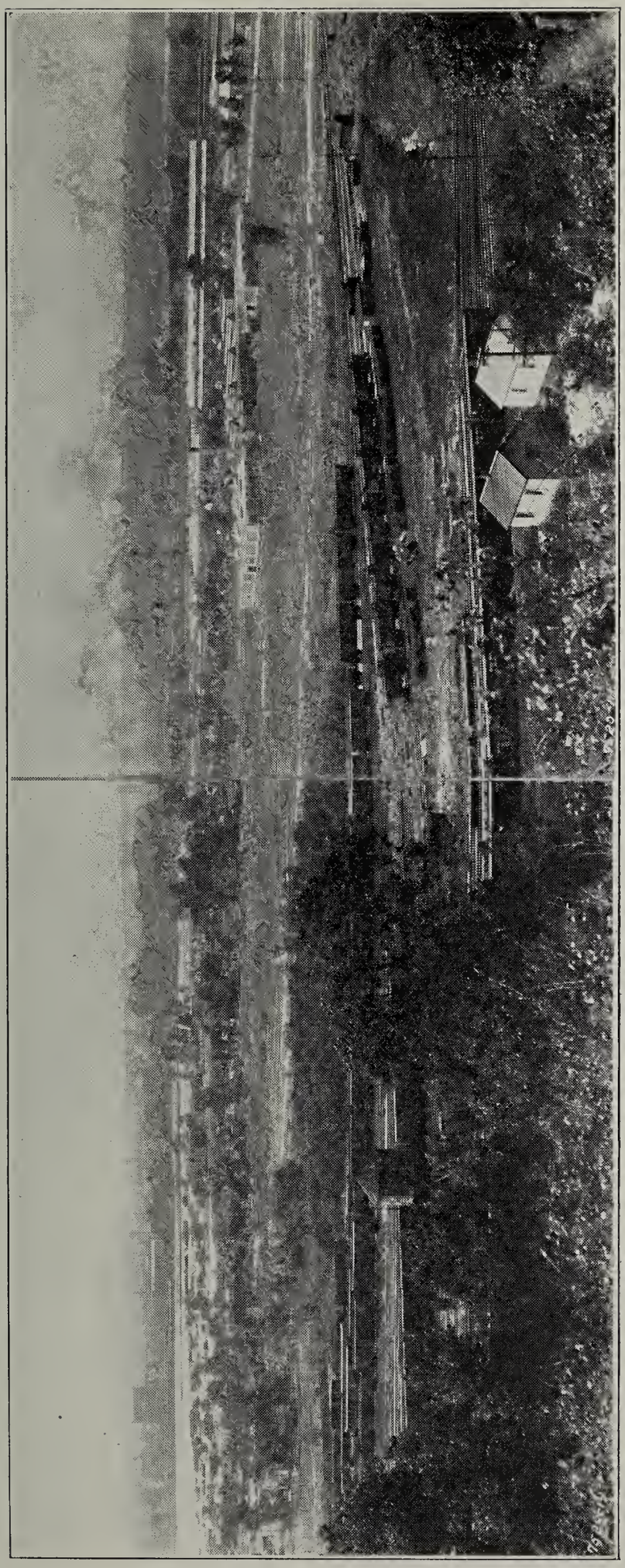
CITY OF EAST PEORIA.

After the flood of 1927, the city of East Peoria, Illinois, found itself in a sad plight. Farm Creek levee had broken and the city had been severely damaged. An inspection by the writer disclosed the following situation:

The City Hall and Fire Station were completely destroyed and three school buildings were damaged to a considerable extent. All equipment of their vocational school was destroyed as well as all janitor's tools and school supplies stored in the basements of these schools. There was also considerable damage to sidewalks and streets and to plumbing and sanitary systems and to building foundations. The Caterpillar Tractor Company, which has a large plant providing work for a large number of the inhabitants, sustained severe losses. This company, together with other manufacturers in the vicinity, had been contemplating enlargements to their plants but the flood menace caused them to hesitate and postpone these improvements.

PUBLIC HEARINGS.

During the latter part of July, as an aid to the investigation of damage claims in the Illinois River Valley, public hearings were held at Peoria, Havana and Beardstown. Representatives of flooded areas were invited to attend and present their reports of damage. Many districts, which had not theretofore sent in their damage claims, were represented at these hearings and their reports were received and the damages classified.



View of East Peoria, Illinois, which was seriously damaged by the flood of 1927.

ORGANIZATION.

The flood relief work was separated, according to location, into two engineering divisions, one known as the South or Mississippi River Division, with headquarters at Anna, Illinois, to care for the Mississippi River and its tributaries in the State of Illinois from Cairo to Edwardsville, and the other known as the North or Illinois River Division with headquarters at Beardstown, Illinois, to care for the Illinois River and its tributaries.

A division engineer was placed in charge of each division and an engineering force organized to work under his direction.

East Peoria City Hall damaged by flood of 1927. Note Fire Department Auto in basement.

METHODS, LETTING OF CONTRACTS.

A standard form for proposal, contract and specifications was prepared and used in nearly all cases.

Following the opinion of the Attorney General, contracts were let in many cases without the formality of advertising for bids, on the unit price, lump sum or "force account" basis as seemed most economical and expedient for the State. As noted elsewhere in this report, on account of the emergency nature of the work, it was a decided advantage to the State to be able to do this. If it had been necessary to advertise and receive bids on the large number of small contracts much time would

have been lost and relief would not have been provided in the districts and land areas when needed.

In the case of large contracts, and in other cases, when possible, competitive bids were received and the contract let to the lowest responsible bidder.

In many cases it was not possible to get contractors to bid on the work because of its locality and the small yardage involved. In such cases contracts were let to a local land owner or farmer who could finance the work. Whenever it was possible and to the State's advantage to do so, contracts were let to local men so that the farmers who had suffered losses might receive needed employment for themselves and their teams.

PROGRESS OF RELIEF WORK.

The Flood Relief Act is primarily an emergency relief measure. To be effective its provisions must be carried out while the emergency exists.

Nickel Plate Railway Bridge over Farm Creek at East Peoria showing drift caught by piers, which practically closed channel—Water overflowed top of Girders and destroyed levees.

Farmers who had lost their crops in the floods of 1926 and 1927 must have their levees repaired so that they could safely return to their abandoned farms, move into their homes and sow a crop of winter wheat in the fall of 1927. The people of the small towns and the cities must be reassured so that confidence would be restored and business and industry which had been partially ruined would take on new life.

At first there was a feeling among the people who had suffered flood damage that the State would not be able to repair the levees in time for the planting of wheat in the fall of 1927 or even for the planting of crops in the spring of 1928. The general opinion prevailed that any

aid to be rendered would require so much time that there would be much additional loss in crops and earnings.

This feeling of skepticism, however, was gradually dispelled by the excellent progress made by our two engineering divisions in the awarding of contracts for levee repairs.

The Flood Relief Act became effective July 1, 1927. Notwithstanding the large amount of necessary preliminary investigation required, the first contract was awarded July 18th and by August 31st twenty-two contracts had been executed for an estimated total of over $111,000.00. By September 30th, forty-six contracts were in force totaling $525,727.00. By the end of December, 1927, there had been awarded seventy-eight contracts for a total of $709,978.00. At the end of the fiscal year, June 30, 1928, 100 contracts have been awarded, totaling $912,313.23.

STATEMENT OF EXPENDITURES.

The following is a statement showing all money expended under the Flood Relief Act, up to the end of the fiscal year, June 30, 1928:

Emergency flood relief	$768,651.85
Salaries and wages, travel, office expense, etc	53,693.42
Total	$822,345.27

RESULTS ACCOMPLISHED.

It may truthfully be said that money being expended by the State of Illinois under the provisions of the flood relief law is of vast benefit to the people of the State and especially to the inhabitants of the flooded areas and neighboring territory and will result in improving the general welfare. Prompt action by the State in carrying out the provisions of the law has restored confidence. Aid arrived when sorely needed. Farmers who had become disheartened by the loss of two years' crops, and whose lands were largely overburdened with debt, were encouraged to continue and were enabled in many cases to establish credit where otherwise credit could not have been obtained.

DIVISION ENGINEERS COMMENDED.

The writer cannot too highly commend the efficiency and loyal cooperation, in the performance of a public duty of the Division of Waterways exhibited by the Division Engineers on the flood relief work.

Mr. William T. Blunt came into our service after a long and honored career as Assistant Engineer in the United States Engineer Department, and his untimely death on March 3, 1928, may have been due to the effect of unusually inclement weather on a day of voluntary duty when his weakened physical condition was concealed by him from his associates.

Mr. L. C. Craig was induced to resign his position as Designing Engineer in the Navy Department at Port au Prince, Haiti, in order that the State might receive the benefit of his previous years of experience in levee and drainage district work along the Illinois River.

Mr. George F. Patrick, fresh from his work as Resident Engineer on the construction of Wacker Drive, Chicago, was placed in local charge of the repair work of the Banner District levees by Mr. Mulvihill before

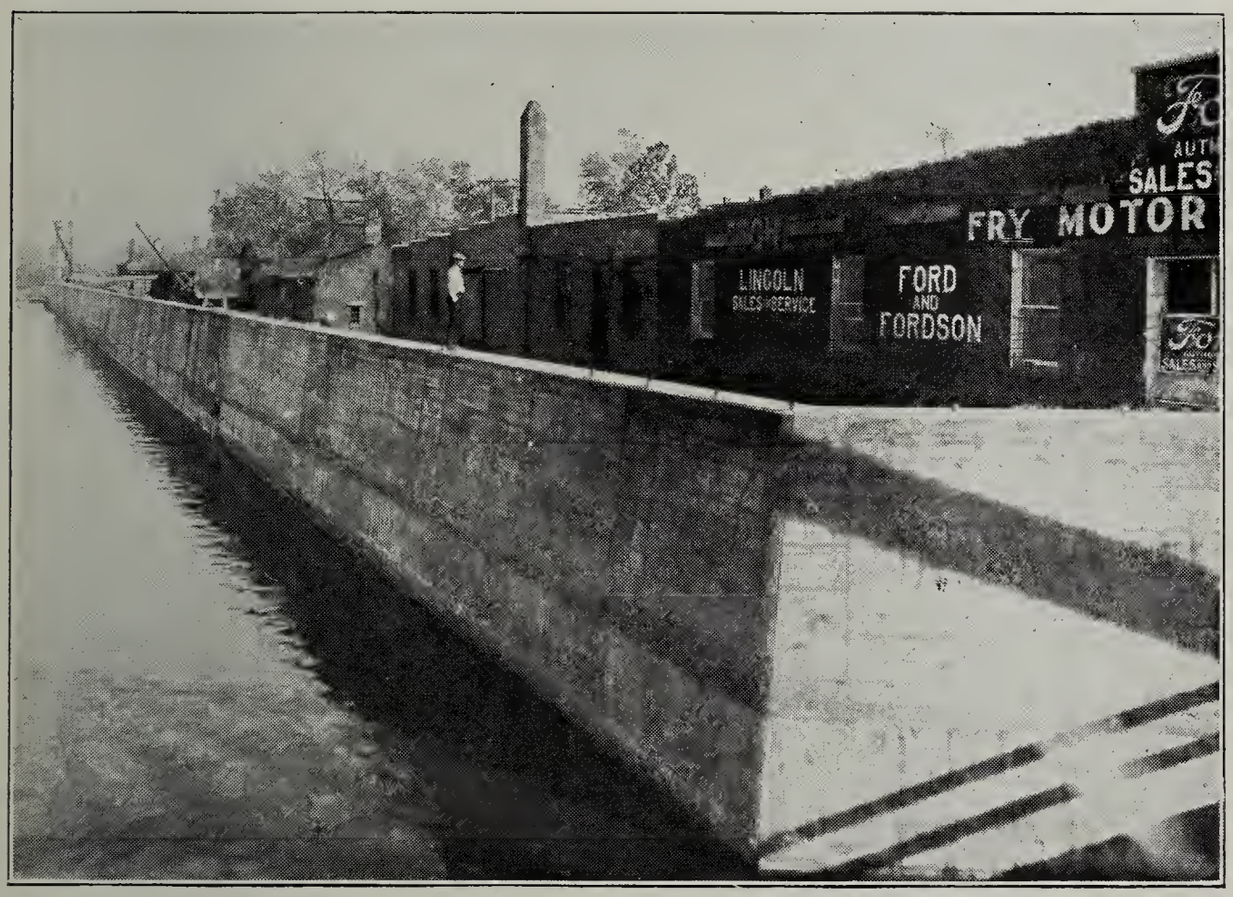
the ink was dry in the Governor's signature to the Act, and he eventually became the Division Engineer of the Southern Division.

Mr. John H. Walker, for many years Assistant to the Chief Engineer of the Fuller Company, was engaged as personal assistant to the writer, and in addition to other duties, handled in a most efficient manner all of the writer's Chicago office routine work in connection with flood relief.

Progress reports of the Division Engineers covering the work of each division appear on pages 94 and 97.

BEARDSTOWN FLOOD RELIEF.

Concrete sea wall and earth levees, designed to protect the city of Beardstown from a repetition of the damages wrought by the floods of 1922, 1926 and 1927, were constructed during the fiscal year.



This concrete wall constructed by the Division of Waterways protects the City of Beardstown from the ravages of the Illinois River. Total cost of protective works including contributions by the railroads and City of Beardstown was over $400,000.

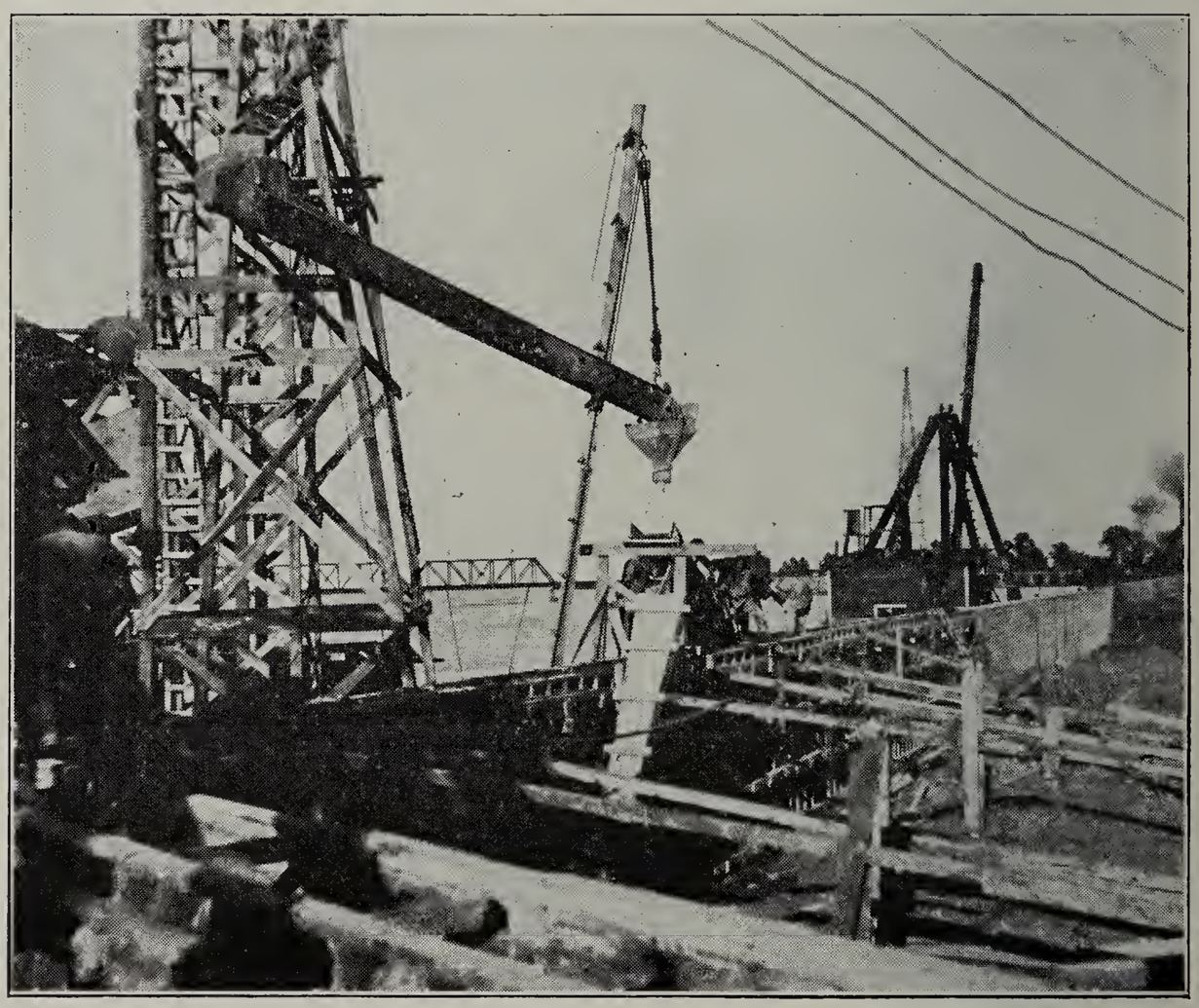
This office prepared several plans with estimates of cost for this work, all of which were described on pages 18 to 29 of our Seventh Annual Report. None of the proposed plans could be carried out for the amount of the appropriation ($350,000) made by the Fifty-third General Assembly. Local interests could not provide the additional funds required and public fear of a repetition of such a flood rapidly subsided. The fall flood of 1926 and spring flood of 1927 again submerged the city for several weeks and definitely aroused the city to the urgent necessity of adequate flood protection.

Mr. Mulvihill and the writer had several conferences with the officials and leading citizens of the city, and eventually additional funds were raised by contributions of $41,000 from the Chicago, Burlington & Quincy and $5,000 from the Baltimore & Ohio Railroads, both of which would be benefited by the proposed improvement, and conditional upon changes in the plans and a time limit for construction.

Proposals for the work were received on May 25, as shown by the canvass of bids on page 61, but the award of contracts had to wait the reappropriation of funds by the Legislature.

TWO PRINCIPAL CONTRACTS AWARDED.

The Fifty-fifth General Assembly on June 30th passed an Act reappropriating $350,000, which Act was immediately approved by the



Building the Beardstown Sea Wall to protect the City from overflow by the Illinois River. This wall is over 3,000 feet long and will protect against a flood stage of 27.75 feet. Projecting from the top of the walls are iron pipes into which flashboards 2 feet high may be quickly fitted providing additional protection. Earth levees connect with the wall at either end extend to the high land back of the city.

Governor, and on the following day, July 1, 1927, the Director signed contracts with the low bidders, J. O. Heyworth, Inc., for the concrete walls, and the McWilliams Dredging Company for the levee work.

The Heyworth Company commenced work on July 25 and continued without interruption, except during a two weeks' flood period, until the completion of the work on December 31. The completion of this work within contract time was an excellent example of sound con-

struction practice which paid dividends. They used steel sheet piling for cofferdams several feet higher than the records indicated as necessary and successfully withstood three high-water periods, during which other work on the river had to be discontinued.

The McWilliams Dredging Company pushed their work vigorously at all times, but owing to adverse weather and frequent but moderate high-water periods, they were seriously delayed, but substantially completed the work by the end of the fiscal year. The levees, as constructed required 498,520 cubic yards of material.

The contract location plans for this work were those of Project 3 on page 27 of the Seventh Annual Report and show six city blocks along the river left outside the sea wall. As finally completed the concrete wall encloses these six blocks and the entire city is now safe from floods three feet higher than the record flood of 1926. This was accomplished by changes in the design, type and location of structures, made during the progress of the construction work.

The contract with Jas. O. Heyworth, Inc., for concrete sea wall work was completed with quantities and costs as follows:

CONCRETE SEA WALL.

Item.	Quantity.		Cost.
Cofferdam	2,208	lin. ft.	$27,600.00
Excavation	10,300	cu. yds.	10,300.00
Concrete	10,952	cu. yds.	98,473.00
Metal work	54.9	tons	11,172.45
Vertical piles	31,556	lin. ft.	23,667.00
Battered piles	8,349	lin. ft.	9,116.45
Backfill	18,220	cu. yds.	10,932.00
			$191,260.90
Cement sacks charged to contractor			5,277.60
Total payment on contract			$185,983.30

EXPENDITURES—BEARDSTOWN FLOOD PROTECTION.

The total expenditures in connection with the Beardstown Flood Protection Work were as follows:

ENGINEERING AND CONTINGENCIES.

Salaries and wages	$6,880.30	
Office expense	447.79	
Travel expense	1,273.59	
Repairs	21.63	
Equipment	31.05	
Advertising and printing	286.30	
		$ 8,940.66

PERMANENT IMPROVEMENT.

Jas. O. Heyworth wall contract—Total payment		185,983.30
Concrete wall, paid for by city of Beardstown		4,300.00
McWilliams Dredging Company levee contract—Total payment		138,281.99
Dessel & Sons, contract for culvert installation at Meredosia road		1,349.54
C. B. & Q. R. R., sewer installation		1,053.66
Cement purchased by State		30,700.08
3 Armco culverts and gates (including gate for Meredosia road)		4,148.19

LAND.

Right-of-way purchases	$22,976.25	
Goodell & Millard	925.91	
C. of C. R. of W. committee	850.00	
Legal expenses paid by Beardstown Sanitary District	176.11	
Right-of-way purchased by city of Beardstown	400.00	
		25,328.27
Total		$400,085.69

The source of funds was as follows:

State appropriation	$350,000.00	
Contributed by C. B. & Q. R. R.	41,000.00	
Contributed by B. & O. R. R.	5,000.00	
Contributed by Beardstown City and Sanitary District	4,876.11	
		$400,876.11
Balance		$790.42
Returned to general fund		661.25
Free available balance		$129.17

No sewers or sewage pumping plants were provided for in the State's plans, nor did these plans provide for maintenance of the levees. A Sanitary District, embracing the entire area, has been created by vote of the inhabitants in order to raise funds to build sewers and to build and operate a pumping plant and maintain the levees.

PRINCIPAL WORK OF THE DESIGNING SECTION.

Report of Walter M. Smith, *Designing Engineer.*

The Designing Department at the beginning of the year consisted of:

1 Chief Designing Engineer.
3 Assistant Engineers.
2 Assistant Engineers on half time basis.
2 Draftsmen.

The work of this force during the preceding fiscal year was 2,630 man days, of which 1,155 man days was on work not connected with Illinois Waterway construction.

The following changes took place during the year:

2 Assistant Engineers were added on July 11th.
1 Draftsman was added on July 19th.
1 Draftsman was added in December.
1 Assistant Engineer was added December 12.
1 Draftsman was added January 13, 1928.
1 Draftsman was added January 16, 1928.
1 Assistant Engineer was added January 16, 1928.
1 Electrical Engineer was added February 1, 1928.
1 Mechanical Engineer was added February 13, 1928.
1 Draftsman was added March 26, 1928.
1 Assistant Engineer resigned on November 30, 1927.
1 Draftsman resigned on March 29, 1928.
3 Assistant Engineers were promoted to Designing Engineers May 1, 1928.

At the end of the year the Designing Department consisted of:

1 Chief Designing Engineer.
3 Designing Engineers.
1 Electrical Engineer.
1 Mechanical Engineer.
3 Assistant Engineers.
2 Assistant Engineers on half time basis.
6 Draftsmen.

The work of this force during the fiscal year totaled 4,493 man days, of which only 474 man days was on work other than for Illinois Waterway design and inspection.

LOCK GATES AND ANCHORAGES CONTRACT 4D.

When the gates at Lockport were allowed to swing on the pintles and hinges it was found that they twisted badly, the miter posts being well out of a vertical line. An additional vertical line of plates was then placed near each end on the upstream side and diagonal tension bars with turn-buckles were placed on the upstream side to adjust the gates to a vertical position and hold them there. This remedied the trouble at once.

DRESDEN ISLAND LOCK AND DAM CONTRACT NO. 3.

This contract was formerly prepared to include only the metal work necessary to embed the masonry. It was decided to revise the drawings and specifications so as to include all metal work except operating machinery. The drawings were revised and specifications were rewritten to conform to this.

Later it was decided to separate the metal work from the masonry at this site, to combine this metal work with that required for the Brandon Road job—except reinforcing steel and certain valves and steel and iron castings for the Brandon Road job which had been purchased outside—and advertise for this as Contract No. 10.

It was also decided to combine the Brandon Road and Marseilles bridges into one contract as Contract No. 11 and to advertise this contract under the same specifications and cover as Contract No. 10.

Specifications and drawings for these contracts were completed ready for printing.

MARSEILLES CANAL AND RIVER EXCAVATION CONTRACT NO. 9.

It was decided to combine the Marseilles Canal excavation and excavation in the various pools in the river and advertise as Contract 9 but to provide that the excavation for Marseilles Canal might be let as a separate contract to that for the pool excavation. Specifications and drawings were prepared and the contract advertised on June 13, 1928.

STARVED ROCK LOCK AND DAM CONTRACT NO. 2.

Designs of cofferdams for the various stages of this contract were submitted and checked. Some changes were recommended and after being made, except in the case of the lower approach cofferdam for the lock the designs were recommended for approval. In case of the cofferdam for the lower approach of the lock in which changes were desired, no revised design was sent in and the cofferdam design in that case was not recommended for approval.

STARVED ROCK METAL WORK CONTRACT NO. 7.

A contract for the metal work required at Starved Rock in addition to that embedded in the masonry was let to the Independent Bridge Company of Pittsburgh, Pa., in November, 1927. Many shop drawings were submitted, checked and approved.

ILLINOIS WATERWAY.

CONTRACT NO 7—CANVASS OF BIDS RECEIVED NOVEMBER 2, 1927.

Item number.	Item.	Unit.	Quantities.	Independent Bridge Co., P. O. box 1920, Pittsburgh, Pa.		Duffin Iron Works, 37 W. Van Buren St., Chicago, Ill.		Ashton and Russell, 168 W. Washington St., Chicago, Ill.		Average of all bids received.	
				Price.	Amount.	Price.	Amount.	Price.	Amount.	Price.	Amount.
A	Cofferdams, pumping, draining and removing	Lump sum	1	$5,000 00	$ 5,000 00	$65,000 00	$65,000 00	$24,000 00	$24,000 00	$31,333 33	$ 31,333 33
B*	Pine and fir timber	1,000 ft. B. M.	1	150 00	150 00	130 00	130 00	163 00	163 00	147 67	147 67
C	White oak timber	1,000 ft. B. M.	17	175 00	2,975 00	230 00	3,910 00	177 50	3,017 50	194 17	3,300 83
D	Wrought iron pipe and fittings	Pound	12,200	15	1,830 00	40	4,880 00	293	3,574 60	281	3,428 20
E	Lock valves complete	Each	4	3,000 00	12,000 00	2,600 00	10,400 00	2,725 00	10,900 00	2,775 00	11,100 00
F	Structural steel	Pound	3,180,000	9 06	305,280 00	1 05	333,900 00	1287	409,266 00	109	349,482 00
G	Steel castings	Pound	123,000	20	24,600 00	18	22,140 00	2743	33,738 90	218	26,826 30
H	Steel forgings	Pound	60,000	30	18,000 00	30	18,000 00	34	20,400 00	313	18,800 00
I	Special steel forgings	Pound	3,000	30	900 00	26	780 00	36	1,080 00	307	920 00
J	Forged monel metal	Pound	15,000	90	13,500 00	1 10	16,500 00	1 217	18,255 00	1 072	16,085 00
K	Metal reinforcements	Pound	77,000	05	3,850 00	07	5,390 00	09	6,930 00	07	5,390 00
L	Spring steel	Pound	2,100	15	315 00	25	525 00	505	1,060 50	301	633 50
M	Cold rolled steel shafting	Pound	7,700	15	1,155 00	20	1,540 00	175	1,347 50	175	1,347 50
N	Gray iron castings	Pound	7,700	30	2,310 00	25	1,925 00	2723	2,096 71	274	2,110 57
O	Lead alloy	Pound	30,400	10	3,040 00	15	4,560 00	162	4,924 80	137	4,174 93
P	Bronze	Pound	2,630	60	1,578 00	75	1,972 50	893	2,348 59	747	1,966 37
Q	Babbitt	Pound	250	60	150 00	1 00	250 00	915	228 75	838	209 58
R	24″ gate valves	Each	2	400 00	800 00	450 00	900 00	490 78	981 56	446 92	893 85
S	3″ gate valves	Each	5	14 00	70 00	18 00	90 00	14 05	70 25	15 35	76 75
T	2½″ gate valves	Each	4	12 00	48 00	18 00	72 00	1 30	45 20	13 77	55 06
U	2″ gate valves	Each	4	10 00	40 00	12 00	48 00	8 47	33 88	10 16	40 63
V	1½″ gate valves	Each	4	8 00	32 00	8 00	32 00	6 99	27 96	7 67	30 65
W	1¼″ gate valves	Each	14	7 00	98 00	8 00	112 00	6 39	89 46	7 13	99 82
X	12″ sluice gates	Each	10	150 00	1,500 00	160 00	1,600 00	152 90	1,529 00	154 30	1,543 00
Y	2″ radiator valves	Each	6	41 00	246 00	7 00	42 00	27 12	162 72	25 04	150 24
Z	Concrete	Cu. yd	540	20 00	10,800 00	50 00	27,000 00	29 25	15,795 00	33 08	17,865 00
AA	Sand	Cu. yd	27	5 00	135 00	5 00	135 00	5 50	148 50	5 17	139 50
BB	Creosoted lumber	1,000 ft. B. M.	37	150 00	5,550 00	140 00	5,180 00	297 00	10,989 00	195 67	7,239 67
CC*	Creosoted wood blocks	Sq. yd	100	4 00	400 00	4 00	400 00	7 83	783 00	5 276	527 67
DD	Electric cable	Pound	36,300	30	10,890 00	42	15,246 00	60	21,780 00	44	15,972 00
EE	Electric cable hangers	Each	34	2 00	68 00	3 00	102 00	5 60	190 40	3 53	120 13
FF	Electric cable racks	Each	322	2 00	644 00	2 75	885 50	4 40	1,416 80	3 05	982 10
GG	Electric cable hooks	Each	1,260	60	756 00	60	756 00	1 37	1,726 20	856	1,079 40
HH	Electric cable supports	Each	150	4 00	600 00	5 00	750 00	8 15	1,232 50	5 72	860 83
II	2″ fiber conduit	Lineal ft	900	30	270 00	60	540 00	57	513 00	49	441 00
	Total				$429,580 00		$545,693 00		$600,846 28		$525,373 09

* Items "B" and "CC" entered for price only.

GATE AND VALVE OPERATING MACHINERY CONTRACT NO. 8.

Drawings and specifications for this contract were prepared and printed, ready for advertising the contract.

ELECTRIC LIGHTING, POWER AND SIGNALING INSTALLATION.

Considerable work was done on the design of the lighting and signaling system for the various locks. In connection with this work the electrical engineer made a very thorough inspection of the corresponding work on the New York Barge Canal and interviewed various operatives as to its success.

COLUMBUS STREET BRIDGE, OTTAWA.

Drawings of operating and end lifting machinery were submitted by the contractors, checked, approved and the machinery installed. Tests were made and the bridge thrown open to traffic.

ROMEO BRIDGE.

Some work was done on the design and drawings for this bridge from time to time but it was not completed.

AUX SABLE AQUEDUCT.

A steel aqueduct was designed to carry the Illinois and Michigan Canal across Aux Sable River similar to the Fox River Aqueduct at Ottawa. Drawings and specifications were prepared, the contract let in November, shop drawings submitted, checked and approved, and the aqueduct built.

FOX LAKE DAM.

Work was begun on design and drawings for a dam at Fox Lake, an appropriation for which was made by the last Legislature. Owing to uncertainty in the bill as to the location of the dam and to a diversity of opinion regarding the same, it was decided to postpone action pending the determination of the questions in dispute.

MC HENRY DAM—FOX RIVER.

A concrete floor was placed on top of the old crib dam at McHenry about two miles below Fox Lake on the Fox River.

MEYERS' BAY BRIDGE, FOX LAKE.

A reinforced concrete bridge at Meyers' Bay, Fox Lake, was designed, drawings made and contract let for construction.

GUM CREEK CULVERT.

A reinforced concrete culvert was designed, drawings furnished, and the structure built by Woods Bros. Construction Co., at the place where Gum Creek passes under the Illinois and Michigan Canal near Marseilles.

MISCELLANEOUS.

PAINT.

Tests of various kinds of paint for painting steel under water which have been carried on for several years by submerging steel plates coated with the various samples of paint in the waters of the Illinois and Michigan Canal at Joliet were continued. The test plates were examined from time to time. Up to the present time nothing has been found equal to pure red lead. This paint calling for red lead of 97 per cent purity has been specified on all our structural steel work.

It was found impossible to get paint with the red lead of this purity without having an analysis made of every order of paint used. This has caused quite an increase in the cost of painting.

DRAWINGS.

The following drawings have been made during the year. These are all standard size drawings.

Original Drawings on paper	63
Finished tracings	205
Tracing paper	19
Cross section paper	3
Total	290

In addition 180 important blue-prints have been given accession numbers and filed for future use. Also 105 shop-prints have been carefully checked, approved and returned to contractors.

REPORT OF R. S. HEATH, RESIDENT ENGINEER.

A report of operations for the Joliet Division on the Illinois Waterway for the year ending June 30, 1928.

CONTRACT NO. 4—LOCKPORT LOCK.

Contract No. 4, for the construction of the Lockport Lock at the end of the Chicago Sanitary District main channel, was practically completed by Green & Sons Company, considerably before the end of the previous fiscal year 1927. However, due to other work being carried out by them on adjacent property for the Sanitary District of Chicago, it was deemed inadvisable to complete such items as cleaning up the site, some painting, etc., at that time.

The only work done during this fiscal year was the removal of the wreckage of the cableway towers damaged in May, 1927; the removal of the cableway beams by the No. 70 Bucyrus shovel, the material from which was deposited along the east edge of the east lock spoil bank; partial clean up of the site; and some extra work. The extras consisted of installing gage boards, gear covers for lift gate machinery and a foot bridge over deep run. Some work was done on the reframing of the old Sanitary District swing bridge to make it suitable for installation across the creek on the new spur track. However, this construction as well as the removal of some excavation on the west bank of the canal was later waived by the Sanitary District.

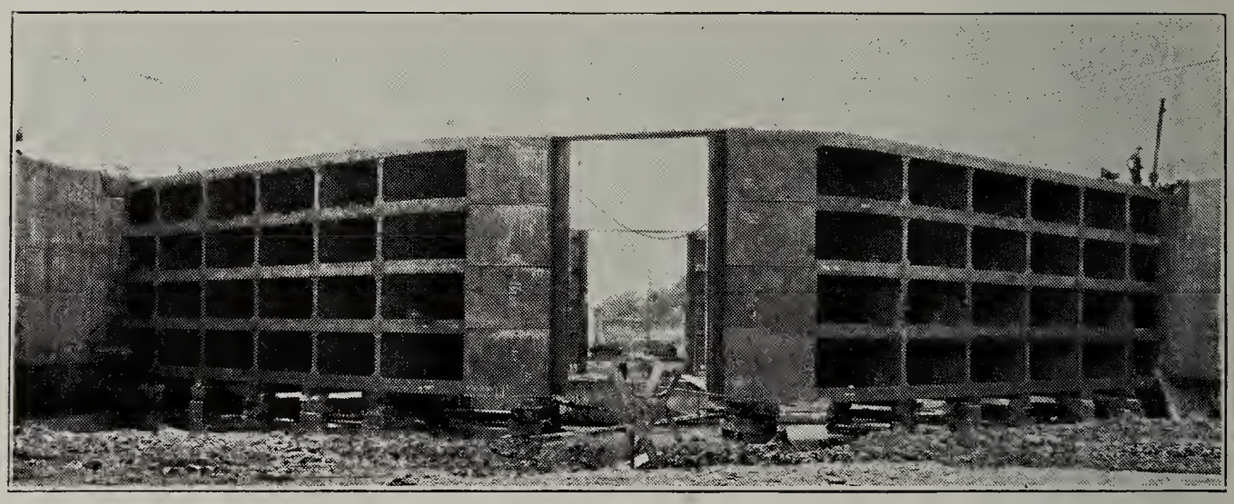
The final voucher was made out in December, 1927, as shown below. Although some equipment still remained on the site it will be removed when the other work for the Sanitary District is completed.

Character of Work.	Quantity Completed.		Amount Earned.
Clearing	100	per cent	$ 8,750.00
Cofferdam	100	per cent	190,000.00
Excavation	148,285.1	cu. yds.	296,570.20
Channeling	46,585.9	sq. ft.	23,292.95
Pine and fir timber	25,838	M. ft.	2,583.80
White oak timber	2,417	M. ft.	483.40
Structural steel	1,485,432	lbs.	148,543.20
Steel castings	60,940	lbs.	10,359.80
Grey iron castings	29,788.1	lbs.	3,574.57
Steel forgings	43,188.3	lbs.	10,365.19
Concrete	91,217.35	cu. yds.	602,034.51
Metal reinforcement	41,623	lbs.	2,081.15
30″ vitrified pipe	15	ft.	75.00
30″ vitrified pipe specials	48	ft.	768.00
24″ vitrified pipe	73.9	ft.	221.70
24″ vitrified pipe specials	11	ft.	132.00
18″ vitrified pipe	450.2	ft.	1,215.54
18″ vitrified pipe specials	39	ft.	312.00
8″ vitrified pipe specials	151.1	ft.	151.10
6″ vitrified pipe specials	1,005.6	ft.	150.84
4″ vitrified pipe specials	99.9	ft.	39.96
Wrought steel pipe and railings	15,187	lbs.	2,278.05
6″ and 8″ cast iron pipe	11,015	lbs.	771.05
Shutter gate valve sets	6		2,340.00
6″ quick operating gate valves	3		120.00
3″ fiber conduit	3,376.8	ft.	1,350.72
Lift gate machinery	100	per cent	40,000.00
50 H. P. electric motors	2		4,000.00
Culvert valve gates	4		8,000.00
Extras Nos. 1, 2, 3 and 4	100	per cent	2,242.39
Extras No. 5	100	per cent	1,400.00
Extras No. 6	100	per cent	228.75
Extras No. 7	100	per cent	362.27
Extras No. 8	100	per cent	1,453.82
Extras No. 9	100	per cent	8,030.07
			$1,374,282.03
Deduction—Personal bond and cement used by contractor			20,374.20
Contract completed—Net total			$1,353,907.83

CONTRACT NO. 4D—LOCK GATES.

Contract No. 4d, for the construction and erection of the lower miter gates at the Lockport Lock, and the upper and lower miter gates and culvert valves at the Marseilles Lock, was well under way at the beginning of the fiscal year. The contract for this work was let to the Independent Bridge Company of Pittsburg, Pa., who sublet the work to the Duffin Iron Co. of Chicago. The latter firm handled the fabrication of the steel work, but sublet the erection to the Powers & Addy Co. of Indianapolis, Ind. Practically all of the steel had been fabricated for both locks and the delivery and erection, except for riveting and anchorage assembly, completed at Lockport during the previous fiscal year. Progress during this year has been very slow. Delays due to excessive caulking necessary on the air chamber at Lockport, failure to provide paint capable of passing the specifications and the employment of insufficient men at Marseilles, retarded the work so that the completion of the painting was impossible before the cold wet weather set in during the winter. The loss of the cofferdam at the lower end of the Marseilles Lock, due to an ice jam causing overtopping on December 20, 1927, also delayed the work.

When the south guard gate at Marseilles was removed from its blocking on November 20th, sufficient lean up stream was noted to make it advisable to install extra end plates and turn-buckles on all the gates.



Two views of lock gate construction at Marseilles, August 12, 1927. Like the others of the series this lock is 110 feet wide, has a usable length of 600 feet with 14 feet of water over the miter sills, and has a lockage capacity of 9,000 tons.

During the summer and fall of 1927 the electrical cables were installed at both locks. This was an extra item and was sublet to the Fries-Walters Co., electrical contractors of Chicago.

Except for a few minor items of cleaning, painting, concrete, etc., at Marseilles, the contract was completed on June 30th.

PROJECTS NOS. 5 AND 6—BRANDON ROAD POOL.

On October 27, 1927, an agreement was signed with Green & Sons Company of Chicago to superintend construction of the Brandon Road Pool (Project 6) and the Brandon Road Lock and Dam (Project 5) on a fee basis, the State furnishing all labor, material and equipment.

PLANT.

Work on Project 5 started on November 14, 1927, when a Link Belt dragline was unloaded at the Chicago Gravel Company's Rockdale Spur. The construction of office building for Green & Sons Co. and

Construction work on Brandon Road Lock and Dam showing excavation for side walls of the lock chamber. Dragline with 100-foot boom in foreground.

State forces was started the next day. Shop and office buildings, yard tracks, gravel storage trestle, track connection across the Illinois & Michigan Canal to the Illinois Traction System and a 6-inch well drilled 800 feet deep, were completed in the spring.

EXCAVATION.

On the 18th of November, 1927, following an inspection trip to the Lockport Lock and a dinner at the Joliet Chamber of Commerce, participated in by commercial interests of Chicago, Joliet and many from all parts of the State, Governor Len Small removed the first shovelful of earth. The Link Belt dragline was used for the purpose.

General excavation was started on January 6, 1928, when the Link Belt began stripping the site of the dam west of the lock and casting the earth to the north to form a dike around the work. This was followed soon after by stripping of the black dirt from the lock site by a 100-foot boom Marion dragline. Rock excavation began April 6th in the west core wall and on May 10th in the lock prism.

CONCRETE.

Concreting starting on April 19th in the east core wall, in the west wall on April 30th and in the lock walls on June 4th. Yard paving mixers were used and serviced by trucks of two and three batch capacity, loaded by bucket conveyors of the caterpillar type with strike-off hoppers.

View of utilities tunnel, 75 feet below the DesPlaines River level at Joliet. Size about 10x15 feet and 350 feet long; excavated through solid rock.

Concrete was placed in the core wall by the Link Belt dragline and in the lock walls by a 115-foot boom steel guy derrick. Blaw-Knox steel traveling forms and a 66-foot belt conveyor were ordered for pouring the walls of the locking chamber.

Other items such as channeling, cofferdams, etc., progressed satisfactorily and the work in general was ahead of the usual progress on such work. The following is the work done to date:

Character of Work.	Quantity Completed.	Percentage Completed.
Excavation	72,101 cu. yds.	23.8
Channeling	16,501 sq. ft.	65.0
Structural steel	1,940 lbs.	0.06
Metal reinforcement	969 lbs.	0.3
Concrete	6,947	4.28
Total job		8.3

GENERAL.

Work on Project No. 6 started on December 15th with the construction of a tool house and office building at the foot of Washington Street in Joliet. Work of laying out lines for the east wall started on December 17th with A. N. Dunaway in charge temporarily. He was relieved on January 10th, when G. P. Fleetwood reported for duty as resident engineer, under whose supervision the balance of the work was carried out.

Part of the core wall of the State Dam at Brandon Road. This wall is 35 feet high and is embedded in solid rock. It is intended to prevent sloughing of earth from saturation or injury to the dam from burrowing animals.

TUNNEL.

The first ground was broken on January 12th when the stripping of the east shaft of the Van Vuren Street tunnel was started, using a Link Belt dragline which was received on January 10th. Rock excavation started on January 21st and proceeded slowly on account of excessive water. All excavating was completed on June 12th except for a little trimming for the two head houses during June. Concreting was started on June 13th and 58 lineal feet were completed by June 30th.

EXCAVATION.

Excavation for the walls was started on May 14th at the intersection of the spillway on the east wall. The Link Belt dragline was

used for this purpose. Earth excavation was completed from Station 32 plus 20.33 to Station 39 plus 00 and rock excavation to Station 34 plus 92. An additional Link Belt dragline was received on June 27th to allow earth and rock excavation to proceed at the same time.

CONCRETE.

Although no concrete was poured on the walls, Blaw-Knox traveling forms for the wall sewers were received and one section at the lower end of the east wall was partially erected. The traveling forms for the east wall were ordered delivered so concreting could start about August 1st.

COFFERDAM.

In addition to the pumping of the Van Buren Street tunnel and the east wall footings, a rock and earth cofferdam was built up along the west side of the east wall from Station 32 to Station 55, using material excavated from the footing and hauling with caterpillar tractors and Athey trailers with hydraulic dump bodies.

The quantities of work done to date are as follows:

Character of Work.	Quantity Completed.	Percentage Completed.
Excavation (Tunnel)	3,331 cu. yds.	99.4
Excavation (Walls)	12,880 cu. yds.	6.25
Concrete (Tunnel)	190 cu. yds.	13.5
Total Job		4.2

REPORT OF

J. B. Bassett, *Division Engineer.*

A report of operations in the Ottawa Division of the Illinois Waterway for the year ending June 30, 1928, is presented below:

CONTRACT NO. 2—STARVED ROCK.

Contract No. 2, let to Woods Brothers Construction Company of Lincoln, Neb., under date of February 5, 1926, provides for the construction of a lock and dam in the Illinois River at Starved Rock, near Utica, Ill. Construction work started by way of excavation by Wilson & Company, sub-contractors, on March 18, 1926, and by June 30, 1927, the contract was about 35 per cent completed.

GENERAL.

Operations at the beginning of the year consisted of the continuation of concrete construction of the lock, the excavation for which had been completed, and the excavation in the upper approach above the cofferdam embankment and by June 30, 1928, the contract was about 75 per cent completed and 12 months behind schedule on account of frequent floods in the previous fiscal year.

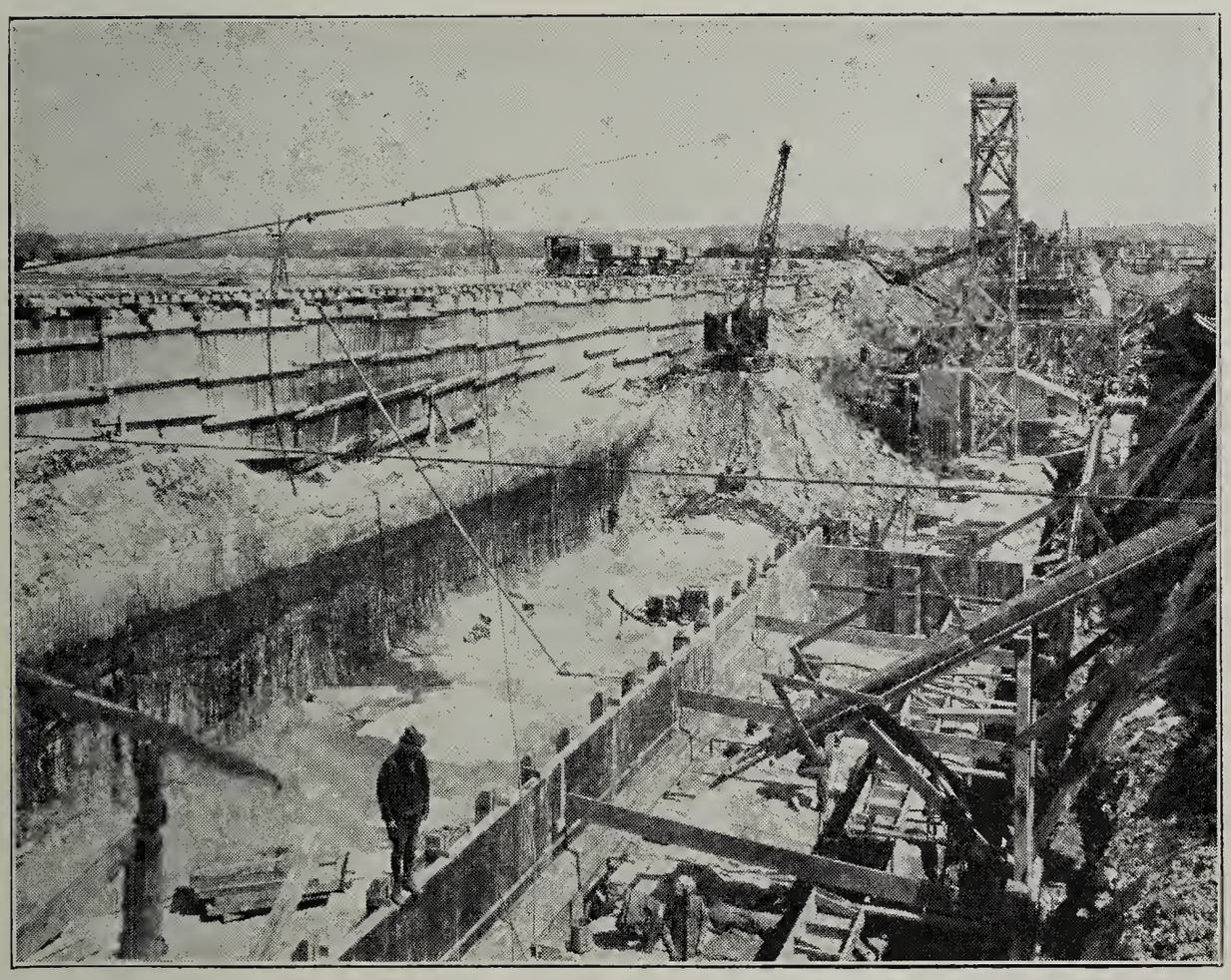
Weather conditions were generally good during the entire year, there having been about 40 days lost time on the work within the main cofferdam, three-quarters of which were due to seasonal conditions during the winter months.

Work within the lower approach cofferdam was discontinued from the latter part of November until the following May, due to flooding from a break in the coffer.

COFFERDAMS.

The cofferdam around the lower approach, the construction of which had been discontinued the previous fall, was carried to completion in July with a top elevation of about 453.0. Excavation within the area was carried on until the cofferdam broke on the 3rd of October. Repairs were made at once and while preparations were under way for the resumption of the excavation, another break occurred on the 19th of October. This break was in turn repaired and work was again under way when another break occurred on the 27th of November.

No further efforts were made in the way of repairs until May, 1928, when the cofferdam was repaired and pumped out. It failed again on



First Section River Cofferdam Starved Rock view from southeast corner looking northwest, April 27, 1928.

June 6th, submerging the excavating machine belonging to the subcontractor. The crevasse was closed and the pit was pumped out sufficiently to allow the removal of the excavator. It was again flooded and the construction of an additional coffer 6 feet wide completely enclosing the old coffer and placed about 3 feet therefrom, was started. The coffer was practically all strung and partially filled, but on the night of the 19th while filling was in progress about 200 feet of the lower end of the river arm fell outward into the river. The impact from dumped filling caused the overturning. The overturned portion was repaired by building a crib of timber and brush on top and filling with earth. The enclosed area was pumped out at the end of the year.

The construction of the first section of the river cofferdam was started in August by the construction of earth levees on the portion on shore. The erection of the box coffer was started in September and both upper and lower arms were extended to and on the island in the river and pumping was started in October to unwater the area between the island and the north bank. The entire structure was completed on November 30th. The area enclosed the balance of the head gate sections, the ice-chute and two complete taintor gate sections. In the meantime a new levee cofferdam had been constructed by dumping earth from the trestle which connected the lock end of the head gate section with the east levee of the lock area. This levee was to prevent flooding of the lock area. On December 19th the earth levee connecting the down-

View of Starved Rock lock looking east from the west embankment. The holes in the side walls of the lock are 12 feet high and provide channels through which the water flows into and is discharged from the lock chamber.

stream arm of the coffer with the shore levee broke by undermining. No particular damage was done and break was repaired and work started inside the coffer on the 30th. On January 23d the outer, upstream corner of cofferdam collapsed by current action washing out the filling. The top portion of the filling was frozen and prevented a settlement which might have stopped the break. This break was repaired and the pit was unwatered on February 13th. There was no further trouble to the end of the year.

CONCRETE.

Concrete operations under way at the beginning of the year were carried on continuously during 1927 until interrupted by cold weather in December. During the winter months repairs were made on the mixing plant and the Blaw Knox steel forms, which had been used for the chamber walls, were dismantled and shipped to the Blaw Knox Co. Operations were resumed in March, 1928, and carried on continuously until the end of the year.

Progress during the last half of 1927 was excellent. On July 1st there had been placed a large portion of the headgate concrete, within the original levee enclosure, and some few sections in the lock around the upper gates on both walls. Blaw Knox steel forms were erected for the straight chamber wall sections and were available for use in July. A double crew was placed in operation in August and the progress was rapid from that time on, resulting in the completion of the lock proper by December with the exception of two floor slabs in the upper gate bay. A portion of upper approach guide was also placed.

Operations from March to the end of June were principally in the headgate and dam sections, the final result for the year being the completion if all lock and upper approach wharf concrete, the completion of the headgate and ice chute, the completion of three taintor gate weirs and the partial completion of three taintor gate piers.

Construction work on Starved Rock Lock and Dam, general view of concrete work from top of mixer plant, October 7, 1927.

CONTRACT NO. 7—STEEL WORK.

A contract for the construction and erection of steel work at the Starved Rock Lock and Dam, consisting of lock gates and valves, drop gates for the headgate structure and Taintor gates for the dam, etc., was let to the Independent Bridge Company of Pittsburgh, Pa.

The field work started on May 28, 1928, by the receipt of working equipment. During June five cars of equipment were received. One unloading derrick was erected and a handling derrick was partially set on the lock wall. A compressor was set up and an office and tool shed were erected. Twelve cars of miscellaneous steel were received and unloaded. Hollow quoin casings, already in place, were lined up ready for backing with lead alloy. Oak sealing timbers were bolted to the headgates.

VALLEY ROAD FILL ACROSS LELAND SLOUGH.

In connection with the Illinois Waterway construction and the proposed raising of the water by the Starved Rock Dam, it was necessary to raise the grade of a portion of what is known as the Valley Road west of Ottawa to bring it above the proposed pool elevation.

The contract for this work was let to Wilson & Company on March 27, 1928, and work started the same day. The only available material for filling was from the waste piles of a gravel plant about one mile away.

A gasoline shovel was installed, some automobile dump trucks were secured and the material was hauled to site. There were about 20,267 cubic yards of material handled in such a manner that traffic was maintained over the fill at all times.

In addition, a reinforced concrete culvert, from the Illinois Highway Department's standard designs with an opening 10 feet wide and 9 feet high was constructed under the fill to allow the passage of creek water. The work was completed on May 31, 1928, for a total cost of $18,414.11.

MAINTENANCE AND REPAIRS TO ILLINOIS AND MICHIGAN CANAL.

COLUMBUS STREET BRIDGE.

The construction of a new highway bridge over the Illinois and Michigan Canal, at Columbus Street, Ottawa, Illinois, was under way at the beginning of the year, having been completed except floor and locking and operating devices. The floor and street car rails were laid early in July, 1927. After some delay in manufacture, the operating and locking devices, with gearing, were received and installed complete on September 16, 1927. The bridge was then turned over to the city of Ottawa for operation.

REPAIRING CANAL BANK AT ROCKWELL.

The Illinois and Michigan Canal bank, at Rockwell, near LaSalle, Illinois, was in bad condition from a lowered top elevation and a diminished width due to wave wash from the Illinois River back water alongside. A contract was let to Wilson & Company who started operations by way of clearing on October 18th.

A plant consisting of a small gasoline shovel, two gasoline locomotives, dump cars, tracks, etc., was assembled and towed to the site on a barge. Material for filling was hauled from an old coal mine culm pile and spread on the bank. The work was completed on December 13th, with many interruptions from bad weather, about 24,636 cubic yards of material having been hauled.

The net result of the work was to produce a bank about 2,500 feet long, lying to the east from Rockwell, with a top width of about 18 feet and a back slope of 1:1-½ to 1. The back slope will flatten from wave wash, but it is thought that a sufficient top width will remain to produce a serviceable bank. The top grade was raised to 3.5 feet above the ordinary navigation stage of water in the canal.

There was also a portion of bank about 700 feet long lying 1,500 feet west of Rockwell which was raised to a uniform grade with a top width of about 10 feet.

AUX SABLE AQUEDUCT.

In January, 1928, a contract was let to the Milwaukee Bridge Company, of Milwaukee, Wisconsin, for the construction and erection of a new steel aqueduct on the Illinois and Michigan Canal over the Aux Sable River. In addition to the steel work certain concrete work was necessary for aqueduct seats on the old piers and abutments and for closures around the ends. This work was let to Wilson & Company, of Ottawa, Illinois, as was also the work of laying a pipe by-pass to allow water to be delivered under contract to certain manufacturing companies, at Morris, Illinois.

On January 27, 1927, work was started on the by-pass; about 283 lineal feet of pipe was laid through the canal banks and down through the river bed, the latter being largely in solid rock. A timber dam was built in the canal prism above the aqueduct and water began feeding through the by-pass on February 10th.

The old aqueduct trough was removed, concrete pedestals placed and the steel work was erected to completion in April by the contractor for the steel.

Wilson & Company closed the ends with concrete, removed the pipe by-pass and the impounding dam and turned the water through the new structure on May 13, 1928.

GUM CREEK CULVERT.

The construction of a new culvert under the Illinois and Michigan Canal, at Gum Creek, Marseilles, Illinois, was placed under contract with Woods Bros. Construction Company of Lincoln, Nebraska.

Operations began on February 9, 1928, with clearing site and the assembly of plant. It was continued through March, April and May to completion on the 31st.

It involved the excavation of the canal banks and the culvert pit, the removal of the old steel culvert, the construction of the new concrete structure; the backfilling and reconstruction of the canal banks, and the straightening of the creek entering the culvert. In addition, a cofferdam was constructed in the canal prism above the aqueduct to maintain water supply contracts.

On May 24th the cofferdam was cut, allowing the canal water to pass over the culvert and the canal was available for use on the 27th.

PAINTING LA SALLE AQUEDUCT.

In the latter part of March, 1927, the work of sand blasting and painting the steel aqueduct on the Illinois and Michigan Canal over the Little Vermillion River, at LaSalle, was let to Wilson & Company.

The plant belonging to the State was assembled and the mud and debris was cleared from the aqueduct, but owing to bad weather there were no operations until the 21st of the following month, when operations were resumed.

The steel work on the entire inside, the vertical outside surfaces and on some badly rusted places on the floor beams was thoroughly cleaned by blasting and was painted two coats of black "Valdura" Gilsonite paint. The painting was done by compressed air, but as a matter of comparison of methods, a small surface on the inside of the aqueduct was painted by hand.

The work was completed on June 1, 1928, and all plant and equipment was removed from the site.

CONTROL OF STREAM POLLUTION.

By M. C. Sjoblom, *Sanitary Engineer.*

After over fifteen years of continuous service with the State in various departments, but all the time on work covering stream pollution, it seems to the writer, that no undertaking of the State can be of greater benefit to the rank and file of its citizens than that of using its authority and power to maintain its streams and lakes in as clean and safe a condition as can reasonably be asked. By this I do not mean returning the streams or bodies of water to the state of purity which existed years ago for that would be attempting the impossible, but to reclaim some of the streams which have now become little less than open sewers, and to prevent undue pollution on such streams as have remained in fair condition.

SOME PERTINENT FACTS.

In attempting to prevent undue pollution and to reclaim some of the streams now grossly overloaded with various wastes, it is necessary to take into consideration a large number of pertinent facts, among others the following:

It is necessary to consider the nature of wastes causing or threatening pollution; to take into account the quantity of wastes and also the dilution available in the stream or body of water to receive these wastes. It is also important to know whether or not the stream passes through a built-up community or through a sparcely settled region. The nature of the stream and the uses to which it is put are other important factors which must be considered.

It is safe to state that domestic sewage, that is, the house wastes from the cities, villages, institutions or individual homes have been responsible for the bulk of the pollution of our streams to date. However, it might be well here to emphasize the fact that industrial wastes of various kinds are playing a large part in stream pollution in this, as well as in other states, and to date treatment of these waters has not received the attention given to that of domestic sewage. The Sate as a whole has come to realize that the domestic wastes from the various communities should receive some treatment and accordingly treatment has been provided in hundreds of cases. On the other hand, the industries as a whole have not shown equal effort toward meeting their similar obligations. But even the industries are beginning to show more interest in their problems of waste disposal than was shown some years ago.

CIRCUMSTANCES ALTER CASES.

In connection with its work of passing on plans for the proposed treatment works for domestic sewage, the State must take into consideration a number of conditions, some of which have been mentioned. It would no doubt be considered unreasonable, at the present time at least, to demand of a small town on a large stream the same degree of treatment as is demanded of a similar town on a small stream affording little or no dilution. To the enthusiast who thinks of streams only in terms of their pristine purity, dilution may be of little value. However, in taking conditions as we find them, dilution must be considered as an important factor in the disposal of sewage. Where adequate dilution is available, sedimentation or fine screening may well be all that can reasonably be required. However, where dilution is inadequate and the stream or body of water receiving the sewage is critically located, further treatment is necessary to prevent nuisance or other damage.

SEWAGE TREATMENT PLANS.

Not only is it desirable that the State be prepared to pass intelligently on the degree of treatment necessary, but it must also be prepared to study the detailed plans submitted and see that they conform to good practice. There are, of course, engineers who are well prepared to design sewage treatment works; but it appears past experience that many engineers who attempt this work have an insufficient knowledge of the subject and often the plans submitted do not provide means for as efficient treatment as might be provided, at little or no additional cost, had the engineer fully understood the art of sewage treatment. In the majority of the plans submitted to the State for consideration it is found necessary to require radical changes before approval can be given for their use. On occasions it has been found necessary to suggest that complete new plans be prepared rather than to suggest the salvaging of the few satisfactory features shown.

PROPER DESIGNS IMPORTANT.

Even though the State retains agencies to check the plans for sewage treatment works, it would be to the distinct advantage of the communities proposing such works were they to secure the services of only such engineers as have by training become specialists in the art of sewage disposal. That this is not done to a greater extent is largely due to the fact that the average layman does not realize the numerous details involved in the proper design of a plant, and their importance in the efficiency of the plant. He too often thinks the civil engineer with a general practice, who perhaps is doing creditable work in looking after the community paving, is qualified to do the work. Often, too, no doubt, he is led to believe that the charges for the services of an expert would be excessive. It is a fact, however, that, as a rule, the sanitary engineer, fully qualified to lay out and supervise sewage disposal works, charges no more than his less qualified competitor and often his superior knowledge in this line of work would save considerable money to the community. It should be remembered too that the State can at best insist

only on such changes as are necessary to insure reasonable efficiency of the plant and can not well demand all the minor changes in the various details which would tend toward making the plant more efficient.

STATE SUPERVISION AIDS COMMUNITIES.

In the work of passing on plans the State has saved thousands upon thousands of dollars to communities, where without State supervision, very inefficient and in some cases worthless units would have been installed, for the inefficient or practically useless plants would have cost as much or more than properly designed plants.

Among the industries which are polluting our streams and bodies of water are gas and coke plants, tanneries, paper mills, starch works, steel works, rendering plants, packing houses, dye plants, asbestos works, creameries, gelatine factories, cheese factories and canning factories. The wastes from these industries and others do not usually equal in volume the domestic sewage from nearby communities. However, most of the industrial wastes here represented, make far heavier demands on the streams, unit for unit of the wastes, than does domestic sewage, and the wastes from a single plant can often create objectionable conditions in nearby streams.

Of the industries mentioned, gas plants have perhaps done as much damage as any, especially so far as fish life is concerned. The objectionable wastes are principally tar, some light oil and other light liquors. Until recently, little effort was made by the gas companies to save the last traces of tar and oil and as a result the bottom of a number of streams were filled with accumulations of tarry deposits. These deposits not only made the stream beds unfit for fish life, while the wastes were entering, but impregnated the bottom and banks to such an extent that years later large oil blotches are raised by stirring the bottom and tar adheres to any object which penetrates the stream bottom as well as banks.

DANGER OF GAS HOUSE WASTES.

A few years ago the State had occasion to investigate the killing of millions of fish in Fox River, immediately below Aurora. Careful investigation indicated conclusively that the local gas company was responsible. In this case it was not the normal plant operation which caused the trouble, but a special situation, namely the use of a temporary apparatus for caring for the wastes, while changes were being made in the treatment plant proper. Only a few days operation of this temporary plant practically exterminated fish life for several miles in the river.

It is not difficult to convince the average layman that gas house wastes should not be permitted to enter a stream, for here the very nature of the waste indicates its objectionableness. On the other hand, it is often quite difficult to convince him that a sparkling clear effluent, such as comes from steel mills where pickling is undertaken and iron sulphate is recovered, may be fully as damaging to fish life. And only too often it is quite difficult to make him understand that wastes from canning factories or milk wastes are dangerous to fish life. But in the case of

these three types of wastes the damage does not lie in the actual composition of the fresh wastes, but in their great demand for oxygen. As soon as they enter a stream they begin taking on the oxygen necessary for their aerobic decomposition, and if the stream is unable to supply the demand and still have a certain amount of dissolved oxygen in reserve, the result is that fish life is exterminated and is again possible only at a point down stream where the wastes will have become stabilized to a point where there demands for oxygen have been reduced and the stream has again taken on sufficient new oxygen.

The general public is demanding, more and more, that treatment of the wastes from the various industrial plants of the State be provided. It is safe to state also that those in charge of these industries are becoming more reconciled to this necessity and in many cases are carrying on experiments of their own, or in conjunction with the State, in the hope of finding adequate and reasonable priced process for treating these wastes. And the cost of treatment processes must remain a big factor in the fight to end industrial waste pollution, for in many cases the cost of adequate treatment works may go far toward deciding whether or not an industry is to be profitable.

COST OF TREATING INDUSTRIAL WASTES.

In connection with the discussion of the cost of treating industrial wastes it might be of interest to mention the situation found in the canning industry. The wastes in the majority of cases are from corn and peas, but there are also a few plants canning beans, pumpkins and tomatoes. Contrary to the general belief, the wastes from these plants make exceedingly heavy demands on the streams per unit of waste entering, compared with raw domestic sewage. But these plants operate as a rule but a few weeks per year and naturally it is quite necessary to keep down the cost of treatment works to a minimum. Were the plant to operate the year around it might be reasonable to require finished and extensive artificial filter units. Under existing conditions, however, it has been found satisfactory, where soil conditions were suitable, to require inexpensive broad irrigation units using sufficient areas of the natural ground to take up the wastes. This means of disposal, alone or connected with fine screening, sedimentation or chemical precipitation, have served most of the plants in the State. Other methods have been employed elsewhere and will undoubtedly be used here later. But the main point to be brought out is, that the State must take into consideration not only the treatment necessary but also the cost involved and whether or not it is justified. Often it is a matter of securing improved conditions at a warranted cost to the industry rather than demanding a prohibitive expenditure which would result only in the industry closing its doors and moving to a point more favorably situated. Often the value of the plant to the community may well be considered of greater importance than the temporary damage to a nearby water course.

After the State has utilized its powers to the end that certain municipalities or industries have provided treatment for their wastes it has still another function to perform. For a large part of the work is left in the form of making investigations to ascertain if the plants installed

are being properly operated. Only too often, a municipality or industry seems to feel it has done its full duty once the treatment plant is installed, and forthwith decides to spend the least possible amount of money for adequate supervision and care. Soon complaints arrive, informing the State of the bad conditions and then it is necessary to have investigations made and if necessary bring pressure to bear to have the plant properly operated.

EMERGENCY FLOOD RELIEF—ILLINOIS DIVISION.

Report of L. C. Craig, *Division Engineer.*

The following is a report covering the operation of the Illinois River Division for the year ending June 30, 1928:

LOCATION.

The work of this Division has consisted in the repair of levees along the Illinois River from Naples to Henry, a distance of about 130 miles and along the Sangamon River and its tributaries, the North Fork and Salt Creek from the mouth of the Sangamon to a point on Salt Creek about 10 miles west of Lincoln. Little work has been done south of Naples as it appears that districts and owners south of that point have been able to repair their own levees.

ENGINEERING ORGANIZATION AND METHODS.

Nearly all contracts for levee repairs have been let on the yardage basis which has necessitated the survey of all damaged levees.

The work has been done by an organization consisting of the division engineer and his assistant and two field parties, each consisting of one instrumentman and two rodmen. In some cases the districts or owners have employed their own engineers who have cooperated with this office.

In all, about 150 miles of levees have been surveyed, of which about 40 miles have been done by local engineers. In addition to the above, many "breaks" have been cross-sectioned.

On account of the wide distribution of the various contracts much traveling has been necessary. Many contracts were located away from the railroad and in view of the difficulty and delay in reaching such points the automobile was relied upon in most cases for transportation.

Office work has consisted of the necessary platting of cross-sections and profiles to determine quantities. Considerable work has also been done in the compiling of sketch maps of the different districts for record purposes.

DISTRICTS SUPPLEMENT STATE AID.

Contracts let to date in this Division, number sixty-six and amount to the sum of $376,512.23. Of this amount about two-thirds has been granted on the basis of 100 per cent aid and one-third on the basis of partial aid varying from 60 per cent to 80 per cent. The above sum, therefore, after adding the portion contributed by districts and owners, represents about $415,700 actually used in restoring levees to their original grade and section.

EQUIPMENT AVAILABLE.

The equipment in use during the past year consists of two large floating clam shell dredges, one dipper dredge and several small drag lines. In addition it was found possible to use the U. S. Government fleet consisting of dredge and dump scows for some work for which it was especially adapted. About 20 per cent of the work has been done by teams and wagons or teams and scrapers.

At the commencement of the work the large clam shell dredge of the Edward Gillen Dock, Dredge & Construction Company was at work for the Banner Special Drainage and Levee District and this dredge soon became available for the State's flood relief work.

Much of the levee repair work was suitable only for floating dredge and it soon became apparent that an additional large dredge was needed. At this juncture the State was fortunate in securing the large clam shell dredge of the McWilliams Dredging Company. This dredge was towed up the Mississippi and Illinois Rivers from New Orleans, and after working for a short period on the new Beardstown levee, became available for flood relief work in December, 1927.

PROGRESS REPORTED.

Sixty-six contracts have been signed to date, of which forty-one are completed and twenty-five are uncompleted.

At the present time applications for repairs which may be allowed amount to $610,129.08, of which contracts have been let for $376,512.23, leaving future contracts to be let amounting to $233,616.85.

The following is a classification of the work of this Division now under contract giving average unit costs:

Class of Work.	Quantity cu. yds.	Av. Cost per cu. yd.	Total Cost.
Teams and scrapers	216,694	0.285	$ 61,172.19
Teams and wagons	23,102	0.515	11,903.70
Dragline	443,824	0.248	106,879.15
Floating dredge	643,514	0.216	139,015.75
Driving piles at breaks	.....	....	5,635.60
Piling and miscellaneous materials	.....	....	8,608.20
Rock rip-rap	.....	....	116.99
Emergency work, sand bagging to hold levees under repair against high water	.....	....	5,114.25
Team work by force account	.....	....	12,000.89
Dragline by the hour (emergency work)	.....	....	7,620.00
Floating dredge by the hour (emergency work)	.....	....	10,125.00
Government fleet West Matanzas	.....	....	8,320.51
Total			$376,512.23

The following is a statement showing the distribution of flood relief work by counties:

Counties.	No. of Contracts.	Amount.
Cass	13	$45,641.78
Mason	13	27,238.32
Pike	5	44,392.07
Morgan	3	7,472.84
Menard	3	12,269.40
Fulton	9	97,400.64
Schuyler	5	33,448.90
Brown	2	18,411.00
Scott	3	1,859.00
Peoria	3	75,304.58
Tazewell	2	4,563.75
Logan	3	6,381.95
Sangamon	1	1,368.00
Christian	1	960.00
	66	$376,512.23

PROBABLE FUTURE WORK.

It is probable that it will be necessary to let about 20 more contracts. It is expected that most of this work will be completed by January 1, 1929. However, on account of lack of available equipment and other reasons it is possible that two or three contracts must wait over until the spring of 1929.

OBSERVATIONS RE LEVEE FAILURES OF 1926 AND 1927.

Of 47 drainage and levee districts which were protected from Illinois River overflow between Henry and Grafton, 23, or approximately 50 per cent, were flooded in the fall of 1926 or the spring of 1927.

The writer during inspection trips, in connection with the work of flood relief, has personally inspected many of the levee breaks and has interviewed engineers and commissioners concerning the immediate causes of these breaks.

The following data, which may be of interest, was obtained:

Of the 23 districts, 9 were flooded from breaks in levees along creek diversions, caused by the excessive local rainfall in September, 1926. One held in the fall, but was flooded from a creek levee break, caused by a local storm in May, 1927, and the remaining 13 districts were flooded in the fall of 1926 by breaks or overtopping of the main or Illinois River levees.

Of the 9 districts mentioned above as flooded from creek levee breaks, 3 were repaired during the winter of 1926-27 and held out the spring flood of 1927, 3 were repaired during the winter and broke again in the spring, and 3 had additional breaks in their river levee, which prevented repairs being made in time to keep out the spring flood.

Of the 23 districts flooded, in only 4 is there a suspicion that the break occurred where the levee section had been weakened by burrowing animals, and in these cases eventually the levee would have been overtopped.

In two districts levees broke where constructed over old lake or slough beds, due to insufficient section and in one district where the levee was built across the channel of a creek and did not break, a bad slide occurred and it was necessary to spend a large sum in sandbagging, etc., in order to hold out the water.

While nearly all levee breaks occurred in the fall of 1926, the greatest damage to the levees themselves was caused by wind storms in the spring of 1927. Many districts having been unable to complete their repairs were flooded continuously during the winter months and their levees badly damaged by wave action.

It was noted that the levees of many districts were being allowed to grow up in brush and timber and in only a few cases was any attempt being made to cultivate a protective growth of grass or sod. It is not known, however, that a growth of timber on a levee contributed in any way to a levee failure during the flood of 1926 and 1927. On the contrary, in some cases small timber growth on the outside slopes and berm of levees afforded some protection from wave action where otherwise, due to absence of any timbered foreshore, no protection existed.

In some cases, the overbank floodways of creek diversions were found to be covered with a thick growth of willows and small timber, so as to greatly interfere with their flood carrying capacity. While it is not known that any levee breaks resulted directly from this cause, it is possible that in some cases the growth of timber in floodways was a factor contributing to some of the creek levee breaks of September, 1926.

In general it may be said that:

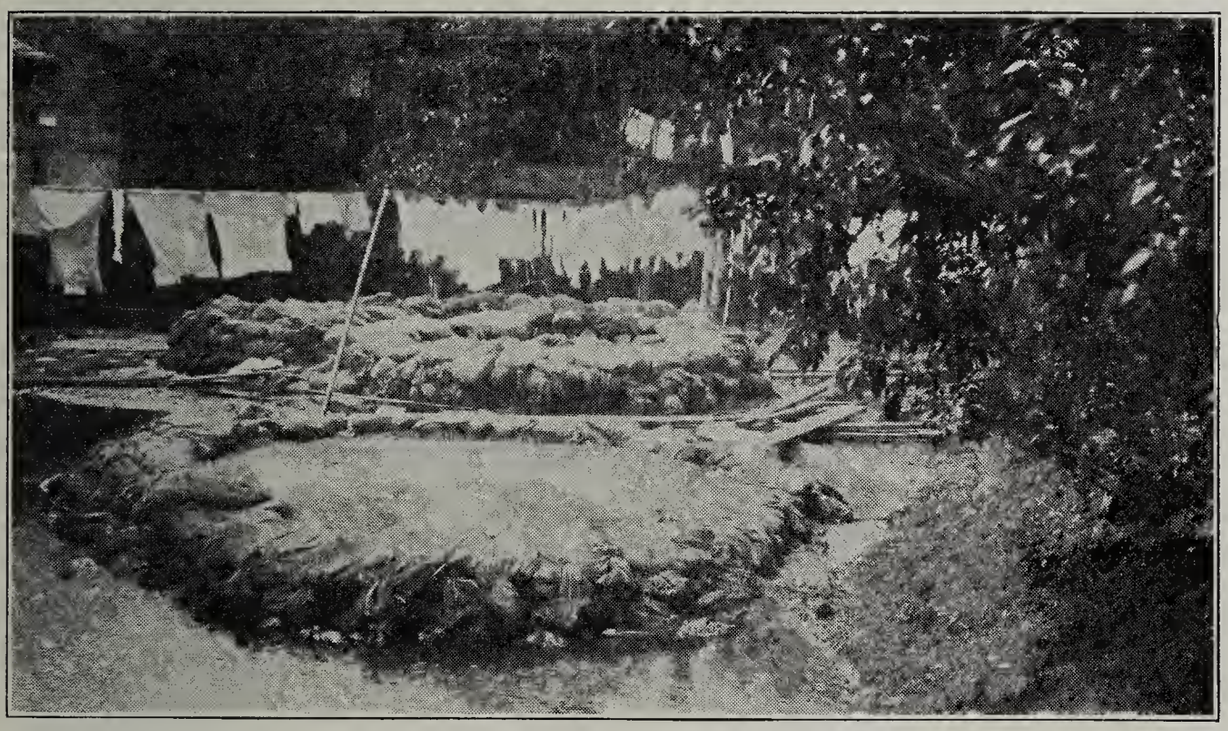
While levee sections should be increased, especially where over 15 feet in height, the levee failures during the floods of 1926-27 were caused directly by overtopping of the levees and not by a weakness of section due to poor engineering design.

While not all levees and floodways along the Illinois River were properly maintained, this fact did not contribute in any great degree to the levee failures of this flood.

EMERGENCY FLOOD RELIEF—MISSISSIPPI DIVISION.

Report of George F. Patrick, *Division Engineer.*

The following is a report covering the operation of the Mississippi River Division in administering flood relief for the year ending June 30, 1928.



Sand boils inside levees at Cairo, Ill., showing use of sand bags to wall up the flow.

LOCATION.

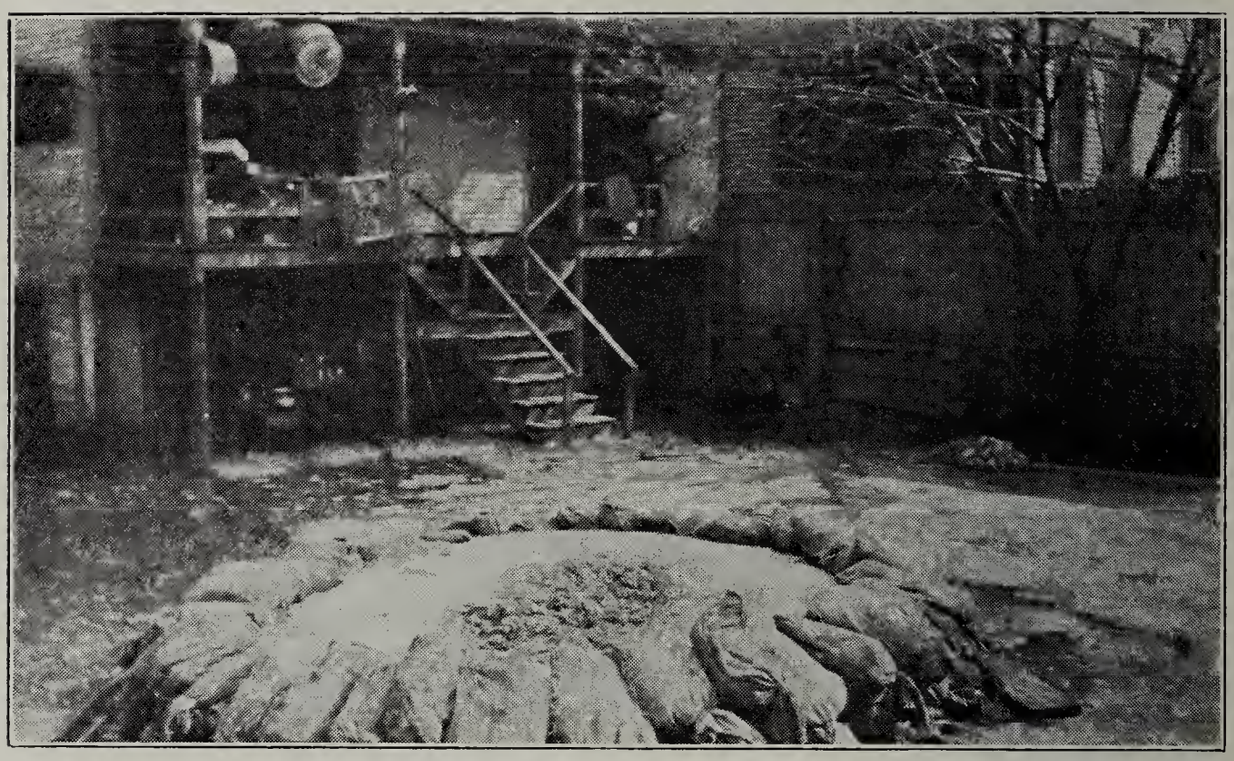
The work of this Division, with offices located at Anna, Illinois, has consisted in the repair of levees along the Mississippi River, the Cache River, the Kaskakskia River, the Big Muddy River and Clear Creek, covering a distance of about two hundred miles, actual work being done in eight counties.

METHODS.

The work has been carried on under the supervision of the Division Engineer aided by the Assistant Engineer and such field parties and inspectors as have been found necessary. In some cases the districts hired their own engineers who did the necessary field work in cooperation with this office. Most of the office work, which consisted of plotting of cross sections, computation of yardage and the making of maps, was done by the Assistant Engineer. Cost estimates originally filed for this Division amounted to $919,530, but the work has been pretty well taken care of through contracts amounting to $535,801.

BENEFITS OBSERVED.

The writer has been able to observe at first hand the benefits resulting from the application of relief to the flooded areas. A majority of the inhabitants living in the flooded areas lost one or two years crops,



Sand boils in rear yard at 224 15th street, Cairo, Ill., flood of 1927. These sand boils are at least 1,000 feet back of the levee.

and in many cases lost their buildings and stocks, and also were in a bad financial condition. The restoration of the levees at State expense enabled them to obtain credit and to start again their farming operations. The letting of contracts locally gave work to the farmers and their teams and helped them to get on their feet.

PROGRESS REPORT.

Thirty-four contracts for work in this Division amounting to $535,-801.00, have been signed to date, of which twenty-seven are completed and seven are uncompleted. The uncompleted contracts will be finished about the first of September, 1928. No new contracts are anticipated at the present time.

The following is a classification of the work of this division now under contract giving average unit costs:

Class of Work.	Quantity Cu. Yd.	Av. Cost Per Cu. Yd.	Total Cost.
Teams and scrapers	334,707	$ .235	$ 88,546.00
Teams and wagons	45,147	.667	30,111.00
Dragline	465,691	.236	109,889.00
Industrial R. R. haul	475,000	.50	237,500.00
Lump sum contracts	.....	.....	53,500.00
Team work by force acct.	.....	.....	13,924.00
Concrete culvert construction	66.6	35.00	2,331.00
Total			$535,801.00

The following is a statement showing the distribution of flood relief work by counties:

Counties.	No. of Contracts.	Amount.
Alexander	9	$308,738.38
Pulaski	2	20,363.84
Union	9	96,961.78
Jackson	5	47,957.00
Madison	2	13,200.00
Randolph	3	17,000.00
Monroe	3	20,750.00
Fayette	1	10,830.00
	34	$535,801.00

ENCROACHMENTS—OBSTRUCTIONS—PERMITS.

Report of W. G. Potter, *Drainage Engineer.*

ENCROACHMENTS ON CAHOKIA CREEK, AT EAST ST. LOUIS.

July 1927, an investigation was made in regard to the present condition of Cahokia Creek, at East St. Louis.

This stream drains much of the territory of the East Side Drainage and Levee District and the hill waters reaching that district. It follows a very tortuous course through the stockyards and railroad district of East St. Louis and empties into the Mississippi in the Southern part of the city.

The Cahokia is crossed by 27 bridges inside the city limits. Originally these bridges consisted of from 8 to 12 spans of trestle, but in many cases, instead of being renewed or rebuilt to the original size, the stream bed has been encroached upon until at present they consist of only two or three spans. Even these narrow channels have been still more restricted and obstructed by cross braces, water and sewer pipes, old piling left in place until now every little channel space is left. In consequence of these obstructions and the encroachments between bridges, in 1927 several square miles of land and several highways were badly overflowed and damaged.

Photos were taken at many of these bridges and encroachments.

In talking over the situation with Mr. John D. Johns and Mr. Putnam, President and Engineer, respectively, of the East St. Louis Drainage and Levee District, I was informed that a project was being agitated to straightened the channel and make a new outlet for the Cahokia, by which many of the bridges would be eliminated and the situation much improved. This depends, however, on agreement between

the district, the stockyards and the railroads as to property rights and expense and is still pending.

The proposed change would be a direct benefit to all interests and was recommended by this Department.

ROCK RIVER SHORE LINES AND ENCROACHMENTS.

Many trips were made to Sterling, Dixon, Rockford, South Beloit and other points, often in company with the U. S. Associate Engineer for that river.

Shore limitation lines were given in numerous places requested by property owners who, in many cases, erected walls on the line given, thus insuring absence of further encroachments in the future. In Rockford, one shore line given necessitated the removal of part of a one story concrete building, which was erected some years ago without permit and in spite of a forbidding order by the U. S.

In this case suit was brought by the U. S. for removal of this encroachment. In order to obtain a shore limitation line for a new building, the owners agreed to remove the encroaching building and the U. S. action is taken out of court.

In another case at Rockford a shore line nearly a half mile long was given and will be marked by a wall.

FOX RIVER SHORE LINES AND ENCROACHMENTS.

Similarly numerous trips to points on the Fox River were made to investigate encroachments or to establish shore limitation lines.

Outstanding among these were the lines given at Aurora by which the C. A. & E. Railroad is enabled to construct a new terminal and a new entrance along the river instead of on a very busy street. In this case, in return for allowing an encroachment on the river bank, the railroad is to remove a large island in the river. The result will be a channel improved in flood capacity, the removal of a very unsightly and obnoxious back yard shore line, and a new terminal for the city which will add much to the assets of the town.

At Elgin also a new shore line has been given, enabling a new terminal for the same road. Shore lines are also being given on the east side of the river and it is expected that a wall will be built by the C. M. & S. P. Railway extending about a half mile along the river.

Encroachments at various points on the Fox have been investigated and stopped. It is the policy of the Department whenever possible to insist on a wall being built on the line established and by doing so avoid further encroachments in the future.

DEVELOPMENTS IN THE LAKE REGION.

With the advent of the automobile a great change is coming to the lake region of northern Illinois.

The city dweller of former days seldom left the city except by rail, and suburban homes were within a circle of very limited radius.

With the automobile the circle is vastly enlarged and is constantly continuing to widen. City residents are reaching farther out each year for homes, for pleasure and relaxation from city life.

In consequence, the beautiful rivers and lakes of our State are becoming more and more valuable each year for summer homes and for recreation. Not only is this true of our lakes and rivers, but in many places dams are being erected in the small streams, thus turning unsightly swamp lands into beautiful lakes and changing the surrounding property into home sites of great value. In other places channels are being cut from the lakes or rivers which drain the swamp lands and make the ground previously of no value into good home site property accessible by either water or highway.

Improvements of this kind are constantly being approved by this Department, thus both adding to the comfort, pleasure and health of our citizens and also adding much to the taxable assets of the State.

PERMITS ISSUED.

The following is a list of permits issued during the year and its comparison with those issued during the previous year.

FORMAL PERMITS.

	1928.	1927.
Docks, piers, retaining walls, etc.	57	57
Sewer systems and treatment plants	20	39
Tunnels, pipe lines, transmission lines and stream crossings	37	40
Dredging, filling, new channels	30	14
Bridges	45	43
Chicago River channel change	0	1
Harbors. intakes and discharges	6	11
Dams	5	4
Drainage districts	5	3
Total formal permits	205	212

LETTER PERMITS.

Piers, channels, etc., in Fox Lake region	48	25
Bridges and culverts on weekly list from Division of Highways	609	461
Total permits issued	862	698

HYDRAULIC INVESTIGATIONS, SURVEYS ETC.

Report of Murray Blanchard, *Hydraulic Engineer.*

Hydraulic investigations of miscellaneous problems when presented were made throughout the year. The entire time for several months was devoted to the preparation of plans, tables, charts, and making computations in the compilation of data for the use of the Chief Engineer at the lake level hearings before Special Master Hughes in Washington and assisting the Chief Engineer at these hearings.

Numerous permits pertaining to dams, channels and other matters relative to the levels of inland lakes were issued.

Plans and specifications were prepared in connection with the river channel excavation of The Illinois Waterway.

Compilation of maps for an extensive right-of-way record of the Illinois Waterway was commenced.

FOX RIVER SURVEY FOR LOCATION OF DAM SITE.

An appropriation was made by the Fifty-fifth General Assembly, "For the construction of a dam and lock in Fox River at or near where the river flows from Nippersink Lake..... $175,000."

It appeared that the most feasible site for a dam to raise the waters of Fox Lake "at or near where the river flows from Nippersing Lake" (if the authorization "at or near" could be construed to intend to contemplate a dam that would raise all of the waters in the Fox Lake chain) would be somewhere in the narrow portion of the river below where it flows from Pistakee Lake.

Accordingly a topographic survey was made in July and August in the narrow portion of the river above the Johnsburg bridge to Pistakee Lake and soundings and borings were made at various sections to test the channel material for suitability as dam sites and foundations.

A map of this survey was prepared. Later the dam below McHenry was repaired and the water level has been maintained above it and in the Fox Lake district at levels that are apparently satisfactory to property owners and all others concerned.

RIVER WORK AT MCHENRY.

The gates of the McHenry lock were rebuilt by Matthews & Tonyan Co., at a contract price of $525.00, including material.

Negotiations with Mr. Bolger were in progress for a year or more in reference to obtaining an easement on his property for a levee along the right bank of Fox River immediately above the McHenry dam. A preliminary agreement was entered into in October but the final agreement was not executed until several months later so that the work stipulated therein had to be postponed until spring.

Preceding this time there was in place a row of steel sheet piling for fifty feet along the right bank of the river, adjoining the west end of the dam, and a levee embankment of inadequate dimensions extended from the upper end of the sheeting along the Bolger property. The levee protection contemplated steel sheeting to join that in place and to extend sixty feet upstream, and from there to the property line a distance of some 300 feet a line of Wakefield sheeting backed by round piles spaced 10 feet center to center and bolted to a 4″ x 10″ waling strip. Back of the pile protection it was proposed to build a line to elevation 738.5 Memphis Datum with a 10 foot minimum top width and sloping back for a distance of 50 feet.

Contracts for this work were let to Julius Keg as follows:

Wakefield protection for $7.20 per lineal foot not to exceed.....	$2,340
Levee 1,500 cubic yards at 50 cents per cubic yard not to exceed.....	750

Contracts for lumber were made in connection with the repair of the McHenry dam and the prices bid were made applicable to this work. The lumber was thus purchased from local dealers. Steel sheeting was purchased (second hand material) from the Equipment Corporation of America at $40.00 ton f. o. b. cars Chicago. Julius Keg contracted for the driving at $2.50 per lineal foot.

The total cost of the Bolger embankment protection works was approximately $3,700.

MEYERS BAY BRIDGE.

An appropriation of $15,000 was made by the Fifty-fifth General Assembly "for reopening of the channel and building a bridge over the channel between Pistakee Bay and Meyer Bay of Pistakee Lake Illinois."

Under this authorization the Division of Highways was requested to submit plans and specifications applicable to this work. A short span, reinforced bridge, with abutments, was called for. Later detail borings and investigations of the bearing material indicated that the ground was not sufficiently solid to support the proposed approach fills of some seven to nine feet in height. Consequently the plans were modified by this office to substitute reinforced concrete bridge approaches in place of the higher portions of the fill with concrete curtains at the ends to hold back the fill material in place of the abutments.

Supplemental specifications adapted to this particular job for use in connection with the standard specifications of the Division of Highways were prepared, the work was advertised and bids were opened on June 20, 1928.

The following bids were received.

Matthews & Tonyan Co., West McHenry, Illinois	$14,168.00
W. H. Shone, Freeport, Illinois	17,800.00
C. E. Carson & Company, Chicago, Illinois	18,400.00

The contract was awarded to Matthews & Tonyan Company.

RECONSTRUCTION OF MCHENRY DAM.

The Fifty-fifth General Assembly made an appropriation, of $10,000, "for maintenance and repair of Fox River Dam, Lock and Fishway at McHenry, Illinois, and for services of custodian for the same."

For carrying out the provisions of a previous Act "authorizing the acceptance by the State of certain land in McHenry County and the acceptances, operations and maintenance of a dam, lock and fishway located thereon," approved June 21, 1923, the Fifty-fourth General Assembly had made an appropriation of $6,500.

The Fifty-fifth General Assembly also appropriated $90,000 for repair of Illinois River locks and for all work necessary for the maintenance of navigation and structures on all Illinois rivers under the Department of Purchases and Construction.

With part of the money from each of the above appropriations the reconstruction of the dam, replacement of lock gates and the construction of the necessary bank protections along the right bank of the river at the west end of the dam was accomplished.

NEW DAMS FOR OLD.

The old dam consisted of a wooden apron on timbers supported by two parellel rows of piling and extending from the lock to the right bank. In front of the entire length of this was driven a row of steel sheeting and bolted to the apron were hinged iron braces spaced 20 feet apart to support flash boards. This timber apron became so rotted and out of repair that the pressure of the water against the flash boards and through the braces was too much for the apron to resist and there resulted frequent breaks in the dam and consequent damage to property.

As the most practicable method to put the dam in good condition, it was decided to replace the wooden apron with a substantial one of concrete. The contracts for this work were made on the basis of unit prices as follows:

Concrete, $7.75 per cubic yard; drive and remove piling, $3.00 per lineal foot; stone fill, $3.30 per cubic yard.

These prices included: Removal of the wooden apron, labor bracing Wakefield, labor setting templates, furnish gravel, labor concreting and placing stones.

The total cost, including emergency work resulting from a broken cofferdam, amounted to about $15,000.

The reconstructed dam is now capable of maintaining a higher backwater level upstream than the banks along the river will hold. To raise the river bank in places upstream from the dam would maintain the stream. However, this capacity is limited to a few inches until such a time as the lock walls and gates are raised.

Fleet of 102 Canal Barges in the La Salle Basin, waiting for the opening of navigation.
From a photograph of April 9, 1865.

ILLINOIS AND MICHIGAN CANAL.

Report of JOHN A. WALTER, *Auditor and Collector.*

SUMMARY SPECIAL CANAL FUND AND ACTIVITY REPORT JULY 1, 1927, TO JUNE 30, 1928.

Balance on hand July 1, 1927		$53,269.67
Receipts July 1, 1927, to June 30, 1928	$36,397.45	
Expenditures July 1, 1927, to June 30, 1928	25,763.47	
Receipts over expenditures		10,633.98
Balance on hand July 1, 1928		$63,903.65

RECEIPTS, JULY 1, 1927, TO JUNE 30, 1928.

Ninety-foot strip, lots and bridge rentals	$16,376.25
Water power rentals	12,492.24
Boat house rentals and level licenses	27.50
Water pipe rentals and miscellaneous	6,440.72
Ice leases	795.00
Certified	22.50
Tolls and lockages	243.24
Total	$36,397.45

EXPENDITURES, JULY 1, 1927, TO JUNE 30, 1928.

Appropriation for I. & M. Canal	$25,763.47
Appropriation for Illinois rivers	45,600.48
Appropriation for aqueduct over Aux Sable River	17,007.03
Appropriation for culvert at Marseilles (Gum Creek)	17,000.00

ILLINOIS AND MICHIGAN CANAL EXPENDITURES, JULY 1, 1927, TO JUNE 30, 1928.

Salary locktenders and officers	$ 8,880.00
Labor pay rolls	13,191.10
Repairs	554.46
Maintenance and operation	3,112.01
Equipment	25.90
Total	$25,763.47

MAINTENANCE NAVIGATION ILLINOIS RIVERS EXPENDITURES, JULY 1, 1927, TO JUNE 30, 1928.

Salary locktenders, collectors and inspectors	$ 5,650.00
Labor payrolls	5,075.23
Repairs	24,519.26
Piling and repairs at dam on Fox River	4,803.55
Maintenance and operation	2,640.80
Dredging at Spring Bay	2,857.92
Equipment	53.72
Total expenditures	$45,600.48

NUMBER OF BOATS RUNNING, TOLLS AND LOCKAGE COLLECTED, AND TONS TRANSPORTED ON THE ILLINOIS AND MICHIGAN CANAL AND THROUGH HENRY AND COPPERAS CREEK LOCKS FOR PERIOD JULY 1, 1927, TO JUNE 30, 1928.

	Copperas Creek.	Henry.	Joliet.	LaSalle.	Channahon.	Total.
Tolls and lockages	----------	$ 83 68	$126 00	$29 45	$1 89	$ 241 02
Boats cleared	----------	26 00	34 00	7 00	3 00	70 00
Tons transported	----------	4,509 00	----------	----------	----------	4,509 00

STATEMENT OF THE PRINCIPAL ARTICLES TRANSPORTED UPON THE ILLINOIS RIVER, CLEARED AT COLLECTOR'S OFFICE AT LOCKS, AT HENRY AND COPPERAS CREEK, FOR THE YEAR ENDING JUNE 30, 1928.

Articles.	Measure.	Copperas Creek.	Henry.	Total.
Corn	Bushel	----------	45,000	45,000
Wheat	Bushel	----------	16,000	16,000
Oats	Bushel	----------	12,500	12,500

ACTIVITY REPORT.

Receipts increased over previous year $608.94 and expenditures decreased $13,399.49, decrease in expenditures due to there being no serious flood damage to the canal banks during the past year.

The balance on hand June 30, 1928, is $10,633.98 more than on hand June 30, 1927, and $51,599.37 more than was on hand July 1, 1917, when the Division of Waterways assumed charge of the Illinois and Michigan Canal.

There was a small increase in tolls and boats using the canal. Due to high water in the Illinois River all boats on the river passed over the dam instead of using the lock at Copperas Creek.

Seventeen new leases for strips of canal reserve were made, nine certified copies of land and lot sale records furnished and one level license issued, three leases expired and buildings were removed from canal land.

Abandoned watchman house near Brandon Bridge was taken down and removed.

Quit claim deed issued for vacated street in Joliet.

Permits issued to: City of LaSalle to use land near Lock 14 to widen approach to bridge; Public Service Company for two transmission lines across canal; Illinois Bell Telephone Company to change location of poles at Crawford Avenue and at Joliet, and to the Santa Fe and Pennsylvania Railroads to reinforce their bridges.

AQUEDUCT AND CULVERT BUILT.

New steel aqueduct over Aux Sable River was constructed and during construction period a flume was installed to keep the canal supplied with water.

New concrete culvert across canal at Gum Creek was built.

South wall of Lock 13 has been repaired and strengthened, minor repairs made to all locktender houses, rebuilt towpath bridge at Aux Sable and installed new waste gates, two new lock gates constructed and are ready to be installed at Lock 9.

The United States dredging outfit removed fill at mouth of the canal west of LaSalle and in the Illinois River at Spring Bay.

The canal was unwatered for four days, between Morris and Marsailles while village of Seneca were installing water main under the canal.

A temporary lift railroad bridge has been built across canal east of Brandon bridge.

HIGH WATER DAMAGES CANAL BANKS.

High water in Illinois River badly damaged by wave wash the banks east of LaSalle, same has been repaired and for a distance of 4,200 feet the bank was raised to grade and widened using coal mine culm from a waste pile alongside the canal.

The interior and exterior of steel aqueduct over the Little Vermilion River was sand-blasted and painted with two coats of asphalt paint.

State dredge outfit removed sand bar 1,130 feet long at Higby, and built up, repaired banks and deepened channel, near Locks 12, 13, 14 and 15, at Blackball, west of LaSalle Street, Ottawa, Seneca and Car-

son Creek. It is the intent to continue raising canal banks and deepening the channel between Channahon and Brandon bridge until navigation closes.

Thirty-one test plates of steel and paints have been immersed in the canal at Jackson Street Lock for testing purposes.

FEDERAL GOVERNMENT TAKES OVER STATE DAMS.

The Federal government takes over the property of the State at Henry and Copperas Creek Locks on July 1, 1928. Notices have been served on all who have leases with the State at these two locks, that their leases are to be cancelled on August 6, 1928, and notices sent to the two collectors and locktenders that their services would terminate June 30, 1928.

Navigation on the canal opened July 17, 1927, and closed on December 8, 1927, and was opened the present season on June 4, 1928, for boats with draft of not exceeding three feet six inches.

Canal structures, banks and the channel are in better condition than at any time during the past few years.

PUBLICATIONS FOR DISTRIBUTION BY THE DIVISION OF WATERWAYS.

Issued by the Rivers and Lakes Commission of Illinois 1911-1916.

* * *

BULLETINS.

No. 1. The Conservation of Water Power in the DesPlaines and Illinois Rivers and the Improvement of these Rivers for Navigation—1911.

No. 2. Prospectus of a project for a Deep Waterway and conservation of a natural resources of the State of Illinois, prepared by Lyman E. Cooley —1911.

No. 3. Uses of the Great Lakes—1912.

No. 4.* Land Drainage in Illinois, by Robert Isham Randolph—1913.

No. 5. A compilation of money spent by the Government on various Harbors, Rivers and Canals, and the riparian property holders benefited—1912.

No. 6. Argument on behalf of the State of Illinois supporting the prayer of the Sanitary District of Chicago for a permit to take 10,000 cubic feet of water per second from Lake Michigan, by Isham Randolph—1912.

No. 7.* The 1912 Flood on the Lower Mississippi, by A. L. Dabney, Consulting Engineer, and "The 1912 Flood in the Ohio and Mississippi Rivers," by H. C. Frankenfeld—1912.

No. 8. Proceedings of the organization meeting of the Association of the Mississippi Valley States for river control—1912.

No. 9. The Illinois Water Power Waterway—1912.

No. 10. The Illinois Waterway—A Guide for Navigators from Lake Michigan to the Mississippi River via the Chicago Sanitary and Ship Canal, the Illinois and Michigan Canal and the Illinois River. Also an Alternate Route via the Illinois and Mississippi Canal—1928.

No. 11.* European Harbor Development, by Robert R. McCormick—1912.

No. 12.* Common Sense applied to the Inland Waterway Problem, by Robert R. McCormick—1912.

No. 13. The Illinois Waterway, A Review, by Isham Randolph—1912.

No. 14. Water Resources of Illinois—A cooperative report prepared by Rivers and Lakes Commission and A. H. Horton, District Engineer of the United States Geological Survey—1914.

No. 15.* The Illinois Waterway—A Project for a waterway of eight feet minimum depth between Lockport and Utica and available for immediate construction—1914.

No. 16. Stream Pollution and Sewage Disposal in Illinois with reference to Public Policy and Legislation, by LeRoy K. Sherman—1915.

No. 17.* Report of Survey and Investigation of LaMoine River, with reference to Flood Control and Navigation.

No. 18.* Flood Control for Pecatonia River—1916.

No. 19.* Projects for a Navigable Waterway from Southern Illinois Coal Fields to Mississippi River—1917.

No. 20.* The Illinois Waterway Report with plans and estimates of cost for a deep waterway from Lockport to Utica by way of the DesPlaines and Illinois Rivers, Internal Improvement Commission—1909.

No. 21.* Surface Water Supply of Illinois, Internal Improvement Commission—1908—1910.

No. 22. Report and (Plans*) for reclamation of lands subject to overflow in the Kaskaskia River Valley, Illinois—1910—1911. Postage 16 cents.

No. 23. Report from the prevention of overflow of the Little Wabash and Skillet Fork Rivers—1911. Postage 16 cents.

No. 24. The Illinois River and its Bottom Lands, by Alvord and Burdick—1915. 2nd Edition 1919.

*Map and Profile of Fox River—1915.

Annual reports of Rivers and Lakes Commission 1912*—1913—1914—1915*—1916.*

ISSUED BY THE

DIVISION OF WATERWAYS

Successor to Rivers and Lakes Commission.

*First annual report—1917-18.

*First Annual Report—1917-18.

Second, Third, Fourth, Fifth, Sixth, Seventh, Eighth, Ninth and Tenth Annual Reports 1918-27, inclusive.

Saline River report 1920 (See Third Annual Report).

Inland Waterways and Transportation Cost by M. G. Barnes, 1920.

No. 25. Big Muddy River Report, 1922—(Also in Fifth Annual Report).

No. 25½. Floods in Illinois, 1922—causes, results and remedies. (Also in Fifth Annual Report).

Pecatonia River Report—1924. (See Seventh Annual Report).

Report of the Interstate Harbor Commission of Illinois and Indiana on Harbor and Terminal Development at the State line between Illinois and Indiana and in Chicago Industrial District—1922.

No. 26. Calumet Lake and Chicago-Nickle Plate Agreement—1926.

No. 27. Laws of Illinois relating to Waterways—1926.

No. 28. National Aspect of Lakes to Gulf Waterway — Diversion of Waters from Lake Michigan—Boundary Waters Treaty, etc.—1926.

* On file in office of Division of Waterways, Chicago. Supply for distribution exhausted.

FOR ANY OF THE FOREGOING PUBLICATIONS, ADDRESS WM. F. MULVIHILL, DIVISION OF WATERWAYS, 220 SOUTH STATE STREET, CHICAGO, ILL.

STATE WATER SURVEY DIVISION
Library

THIRTEENTH ANNUAL REPORT

OF

DIVISION OF WATERWAYS

OF

THE DEPARTMENT OF PURCHASES AND CONSTRUCTION

July 1, 1929

TO

June 30, 1930

HENRY H. KOHN, Director
THOMAS WILLIAMSON, Assistant Director

WILLIAM F. MULVIHILL,
Supervisor of Illinois Waterway Construction

L. D. CORNISH, Chief Engineer

Chicago Office, 220 South State Street

[Reprinted from the Thirteenth Administrative Report. Printed by authority of the State of Illinois.]

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THIRTEENTH ANNUAL REPORT

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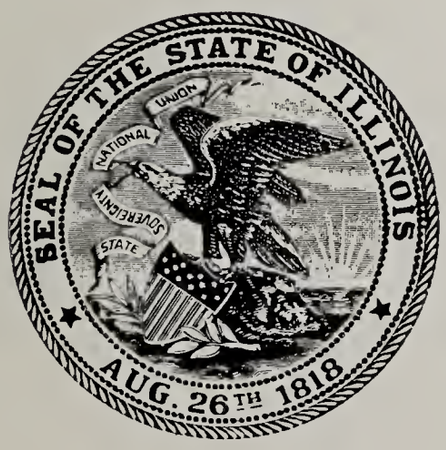

HENRY H. KOHN, Director
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WATERWAYS.

Wm. F. Mulvihill,
Supervisor Illinois Waterway Construction.

The Thirteenth Annual Report of the Division of Waterways of the State of Illinois covers the fiscal year beginning July 1, 1929 and ending June 30, 1930.

"THE ILLINOIS WATERWAY" TO BE A FEDERAL PROJECT.

The past year has been a most eventful one, the climax of interest centering in the passage by Congress of the Rivers and Harbors bill which, among other things, adopted "The Illinois Waterway" as a Federal project and authorized an appropriation of $7,500,000 to complete the navigation structures, heretofore designed and largely constructed by this division.

CONGRESS TO COMPLETE, MAINTAIN AND OPERATE.

Under the act of Congress above referred to the Federal Government undertakes to finish construction of the uncompleted dams, locks and other essential structures and the dredging required for 9 foot navigation of this connecting link between the Great Lakes system of inland waterways and the Mississippi river system, and to maintain and operate the same.

ADDITIONAL FUNDS NEEDED.

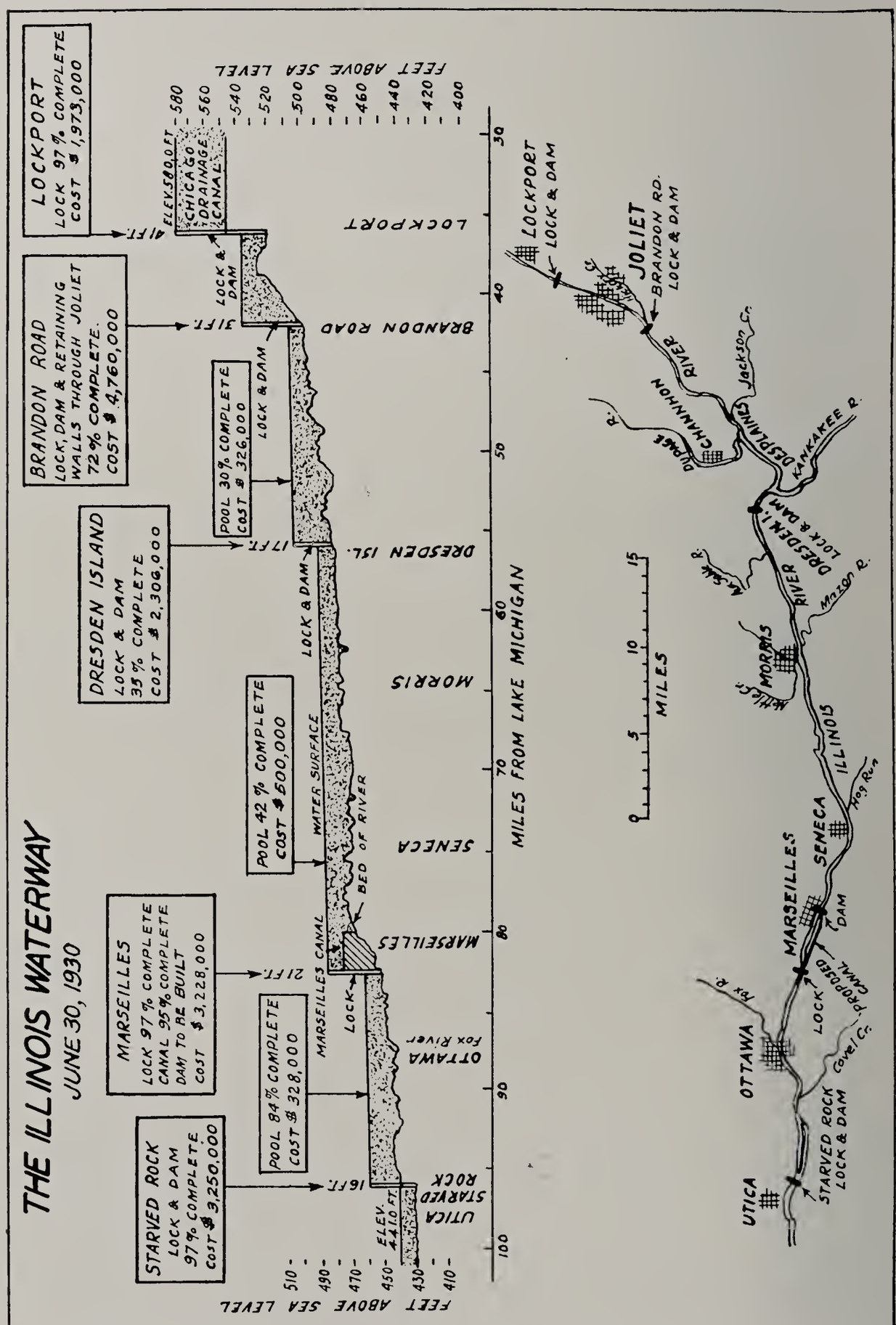
The reason for the Federal action may be found in the fact that the State bond issue of $20,000,000, authorized by constitutional amendment in 1908, was found to be insufficient, owing to increases in construction costs, due to the war, to complete the navigation structures and also to reconstruct the highway bridges across the waterway, which would be rendered unusable on account of the change in water levels.

STATE MUST REBUILD BRIDGES.

As a condition of Federal aid being extended, the State of Illinois is required to rebuild all present highway bridges which will be interfered with by reason of the waterway construction; also to build two new bridges across appurtenant artificial channels. The law provides, not only that the State must construct these bridges, but also requires that any unexpended balance in the "Illinois Waterway Fund" after such bridges are built, shall be expended by the State in doing such other waterway construction work as may be directed by the Secretary of War.

NO FEDERAL FUNDS NOW AVAILABLE.

As the Rivers and Harbors bill did not become a law in time for the authorized appropriation for this project to be included in the reg-

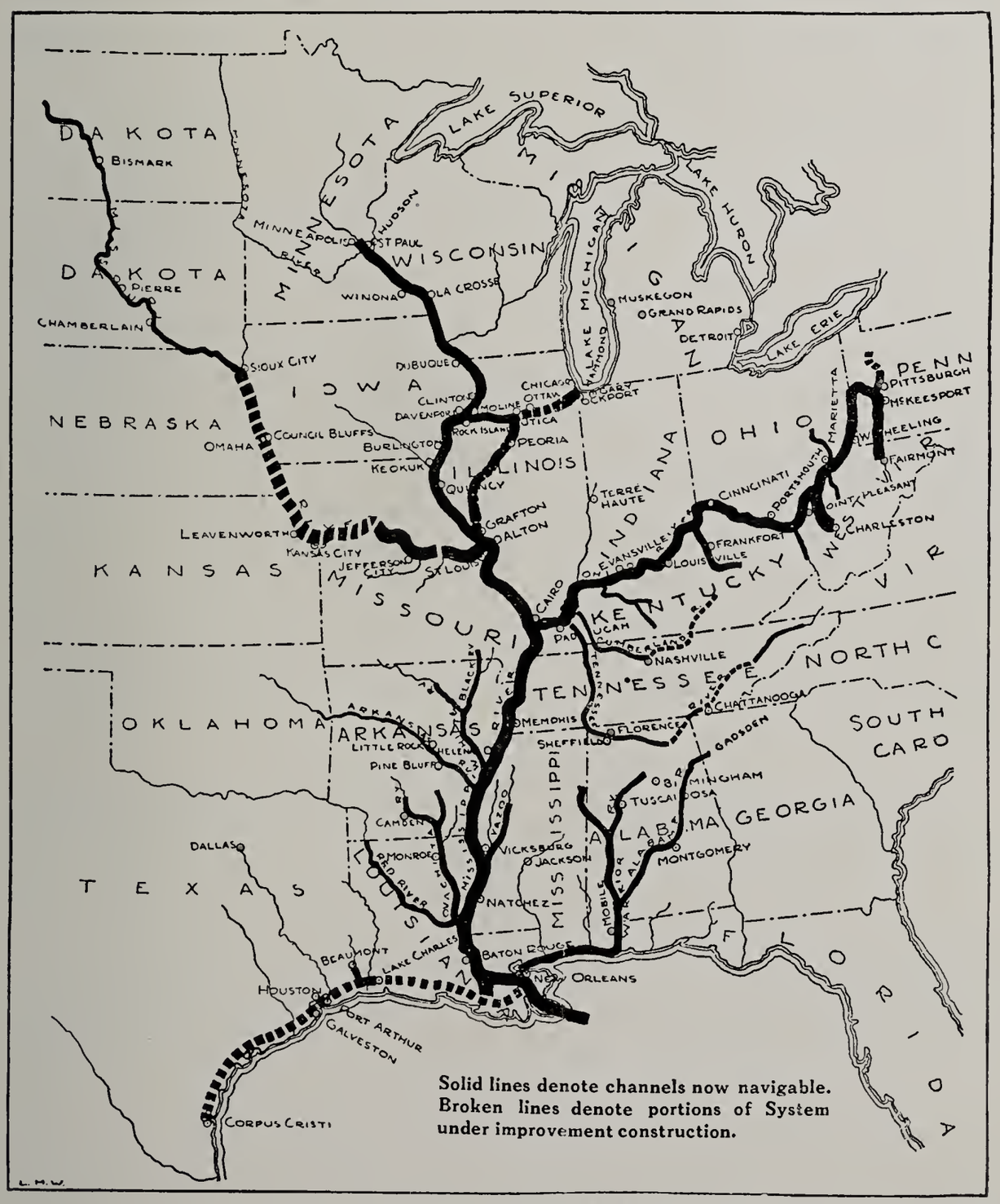

THE ILLINOIS WATERWAY
JUNE 30, 1930
LOCKPORT
LOCK 97% COMPLETE
COST $1,973,000
BRANDON ROAD
LOCK, DAM & RETAINING WALLS THROUGH JOLIET
72% COMPLETE.
COST $4,760,000
DRESDEN ISLAND
LOCK & DAM
35% COMPLETE
COST $2,306,000
MARSEILLES
LOCK 97% COMPLETE
CANAL 95% COMPLETE
DAM TO BE BUILT
COST $3,228,000
STARVED ROCK
LOCK & DAM
97% COMPLETE
COST $3,250,000
POOL 30% COMPLETE
COST $326,000
POOL 42% COMPLETE
COST $600,000
POOL 84% COMPLETE
COST $328,000
41 FT.
31 FT.
17 FT.
21 FT.
16 FT.
ELEV. 580 FT.
CHICAGO DRAINAGE CANAL
LOCK & DAM
WATER SURFACE
BED OF RIVER
MARSEILLES CANAL
LOCK
ELEV. 447.0 FT.
LOCKPORT
BRANDON ROAD
DRESDEN ISL.
MORRIS
SENECA
MARSEILLES
OTTAWA
Fox River
UTICA
STARVED ROCK
FEET ABOVE SEA LEVEL
MILES FROM LAKE MICHIGAN
MILES
LOCKPORT
LOCK & DAM
JOLIET
BRANDON RD.
LOCK & DAM
CHANNAHON
DUPAGE R.
RIVER
Jackson Cr.
DESPLAINES
KANKAKEE R.
DRESDEN I.
LOCK & DAM
RIVER
Mazon R.
MORRIS
Mill Cr.
ILLINOIS
Hog Run
SENECA
MARSEILLES
DAM
LOCK
PROPOSED CANAL
Fox R.
OTTAWA
Covel Cr.
STARVED ROCK
LOCK & DAM
UTICA

ular army appropriation bill for 1930, no Federal funds are yet available for going on with the construction work.

STATE WORK SHUT DOWN.

Because of the necessity of holding back sufficient State funds to pay for the bridges required to be built, the aggressive construction program which this division has pursued for the past three or four years had to be curtailed, and finally given up altogether, except for essentially emergent work, necessary to protect existing structures or in completion of such contracts as could not be cancelled without great financial loss and damage.

THE MISSISSIPPI SYSTEM



"The world's most extensive waterway system which flows to a warm and friendly sea thruout the world's most prosperous valley.

STATUS OF VARIOUS PROJECTS.

No new contracts were let during the fiscal year, and very little work done at Lockport which was 97 per cent complete during the previous year. The Marseilles and Dresden pool work remain as before.

The work on the Brandon road lock and dam and the retaining walls through the city of Joliet is now 72 per cent completed, as compared with 45 per cent one year ago.

The Dresden Island lock and dam are 35 per cent finished against 25 per cent June 30, 1929 with 42 per cent of pool dredging now completed against 39 per cent.

The status of work on the Marseilles lock was changed from 92 per cent of completion to 97 per cent and the excavation of the Marseilles Canal was boosted from 47 per cent to 97 per cent.

The Starved Rock lock and dam, which were 78 per cent complete a year ago are practically finished at this time.

The construction work on the Illinois Waterway during the fiscal year is indicated by the following table of monthly expenditures:

ILLINOIS WATERWAY FUND.

Expenditures for the Fiscal Year July 1, 1929, to June 30, 1930.

July, 1929	$507,688.45
August	646,383.54
September	626,516.14
October	540,437.43
November	530,754.53
December	456,287.76
January, 1930	253,979.39
February	191,209.01
March	96,766.76
April	183,181.00
May	129,867.44
June	227,589.84
Total	$4,390,661.39

The status of construction is given in the report of the chief engineer and is graphically shown by the map and chart printed on page 6.

FLOOD RELIEF WORK.

The last legislature appropriated $1,849,229.47 for flood control, of which sum $219,229.47 was a reappropriation of the unexpended balance of the 1927 emergency flood relief act.

Flood relief work was carried on during the year, much of it in conjunction with the Federal government, in which cases the State allotment would not exceed one-third of the cost, the remaining two-thirds being provided from Congressional appropriations. Expenditures and existing contract obligations amount to about $300,000 for the year.

NEGOTIATIONS WITH FEDERAL AUTHORITIES.

The negotiations between the State administration and the Federal government, regarding completion of the Illinois Waterway by the latter, were largely conducted by Governor Louis L. Emmerson, and Attorney General Oscar E. Carlstrom, in behalf of the State, and by

the President, Secretary of War and Chief of Engineers for the United States. This division was called upon, from time to time, to furnish such expert and detailed information as was considered necessary.

RIVERS AND HARBORS ACT—ILLINOIS RIVER.

The law as finally enacted by Congress and later approved by President Hoover, is entitled "An Act, authorizing the construction, repair, and preservation of certain public works on rivers and harbors and for other purposes." That part of the law relating to the Illinois Waterway reads as follows:

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the following works of improvement are hereby adopted and authorized, to be prosecuted under the direction of the Secretary of War and supervision of the Chief of Engineers, in accordance with the plans recommended in the reports hereinafter designated. * * *

Illinois River, Illinois, in accordance with the report of the Chief of Engineers, submitted in Senate Document Numbered 126, Seventy-first Congress, second session, and subject to the conditions set forth in his report in said document, but the said project shall be so constructed as to require the smallest flow of water with which said project can be practically accomplished, in the development of a commercially useful waterway: *Provided,* that there is hereby authorized to be appropriated for this project a sum not to exceed $7,500,000: *Provided, further,* that the water authorized at Lockport, Illinois, by the decree of the Supreme Court of the United States, rendered April 21, 1930, and reported in volume 281, United States Reports, in Cases Numbered 7, 11 and 12, Original—October term, 1929, of Wisconsin and others against Illinois, and others, and Michigan against Illinois and others, and New York against Illinois and others, according to the opinion of the court in the cases reported as Wisconsin against Illinois, in volume 281, United States, page 179, is hereby authorized to be used for the navigation of said waterway: *Provided, further,* that as soon as practicable after the Illinois Waterway shall have been completed in accordance with this Act, the Secretary of War shall cause a study of the amount of water that will be required as an annual average flow to meet the needs of a commercially useful waterway as defined in said Senate document, and shall, on or before January 31, 1938, report to the Congress the results of such study with his recommendations as to the minimum amount of such flow that will be required annually to meet the needs of such waterway and that will not substantially injure the existing navigation on the Great Lakes to the end that Congress may take such action as it may deem advisable.

QUOTATIONS FROM DOCUMENT NO. 126.

Senate Document No. 126, Seventy-first Congress, second session, referred to and made a part of the Rivers and Harbors Act of 1930, as noted above, was presented to the U. S. Senate April 7, 1930, by Senator Otis F. Glenn of Illinois. It consists of 87 printed pages, and covers the report of Major General Lytle Brown, Chief of Engineers, United States Army, to the chairman of the Committee on Commerce of the Senate, and contains a review of reports previously submitted to Congress "with a view to the extension of free navigation, with a 9 foot channel from Utica (Illinois) to Lake Michigan."

CHIEF OF ENGINEERS REPORT.

The following excerpts from Document No. 126 seem essential to a clear understanding of the present status of the Illinois Waterway project:

THE ILLINOIS WATERWAY.

War Department,
Office of the Chief of Engineers.
Washington, D. C., April 3, 1930.

Hon. Hiram W. Johnson,
Chairman Committee on Commerce,
United States Senate, Washington, D. C.

My Dear Senator: 1. Referring to a letter of the chairman of the Committee on Commerce of the United States Senate, dated November 20, 1929, inclosing a copy of a resolution of your committee of the same date, requesting the Board of Engineers for Rivers and Harbors to review the reports submitted in House Document No. 112 and House Document No. 220, Fifty-sixth Congress, second session, with a view to the extension of free navigation with a 9-foot channel from Utica to Lake Michigan, I inclose herewith the report of the board in response thereto.

2. The documents under review presented estimates of the cost of a waterway from Utica on the Illinois River to Lake Michigan at Chicago, with depths of 8 and 14 feet, following in general the line of the Illinois and Des-Plaines Rivers from Utica to Lockport, and thence the Chicago Sanitary Canal and the Chicago River and its connecting waters to Lake Michigan. The supplementary route to Lake Michigan by way of the Sag Canal and the Little Calumet and Calumet Rivers was also considered. These reports stated that a 14-foot waterway, suitable for use by lake vessels, was not justified at that time and contained no specific recommendations with respect to the 8-foot waterway.

NINE FOOT DEPTH PROJECTED.

3. The existing project for the improvement of the Illinois River provides for a channel at least 9 feet deep and 200 feet wide from Utica to its mouth, at which point it connects with the recommended 9-foot project on the Mississippi River. There are also Federal projects in the Chicago and Calumet Rivers which provide depths suitable for large lake vessels for some distance above the mouths of these streams. These Federal projects are connected by a system of waterways constructed by non-Federal interests. The Sanitary District of Chicago has constructed an artificial canal, usually referred to as the Chicago Sanitary Canal, which extends from the west fork of the Chicago River to the DesPlaines River near Lockport, and has also done considerable work in enlarging the channel of the south branch and west fork of the Chicago River between the head of the Federal project on that river and the head of the sanitary canal. The sanitary district has also constructed a branch canal, known as the Sag Canal, connecting the sanitary canal with the Little Calumet River, and has deepened and enlarged the channel of the portions of the Little Calumet and Calumet Rivers connecting this canal with the head of the Federal project on the latter stream. On all of these waterways the existing depths are considerably greater than 9 feet. The final link of this waterway system is the so-called Illinois Waterway, which is being constructed by the State of Illinois under permit by the Secretary of War, and extends from the foot of the Chicago Sanitary Canal at Lockport to the head of the Federal project on the Illinois River at Utica.

DESCRIPTION OF LOCKS.

4. Construction of the Illinois Waterway was begun in 1921. It includes four locks and dams and a fifth lock forming the connection with the Chicago Sanitary Canal at the forebay of the Lockport power house. The waterway follows in general the DesPlaines and Illinois Rivers, but there are short sections of artificial canal at Lockport and at Brandon road, and a section of such canal about 2½ miles long around the rapids at Marseilles. The locks have the same horizontal dimensions as those of the Ohio River improvement, being 600 feet long and 110 feet wide. The depth on the miter sills is different in different locks, but the minimum is about 14 feet.

The other portions of the waterway are designed to have a depth of 8 feet. The waterway is crossed by 15 fixed bridges, which must be replaced by movable bridges. Five of these are privately owned railroad bridges and 10 are publicly owned highway bridges. In addition, two new highway bridges will be required crossing the artificial canals at Marseilles and Brandon Road.

VALUE OF POWER RIGHTS.

5. In connection with the construction of the Illinois Waterway there are four sites at which water power could be developed. It was originally expected that the receipts from the sale or lease of this power would be sufficient to pay the interest on the $20,000,000 bond issue and to retire the bonds at maturity. This opinion appears to have been based on conditions as they existed in 1908 and on an exaggerated conception of the value of these water powers even under those conditions. Subsequent developments have so modified physical and economic conditions that it is now clear that the value of these water powers is very much less than was originally estimated. It is now stated that the State has abandoned the hope that the receipts from the sale or lease of power would pay the cost of the waterway and that, if the United States undertakes to complete, maintain, and operate the waterway, the officials of the State are willing to relinquish any rights which the State may have or claim in the development of these water powers. Since all these water-power sites are located on navigable waters it appears that they can not be developed except under license from the Federal Power Commission, and if the United States completes and operates the waterway, it is doubtful if the State will have any power rights of real value.

WORK ABOUT 75% COMPLETED.

6. Although the constitution of the State of Illinois prohibits in general terms the use of the State's funds or credit for the construction of waterways, a special amendment adopted in 1908 authorizes a bond issue of $20,000,000 for the construction of this waterway. To secure additional funds for this purpose would require another constitutional amendment and it is estimated by persons familiar with the local situation that from 4 to 6 years would be required to secure the passage of such an amendment.

7. The State has spent about $15,500,000 on the construction of the proposed Illinois Waterway and the physical work is now about 75 per cent completed. However, it has been found that the total cost of the waterway, including the necessary bridges, will be considerably in excess of the $20,000,000 which is available for its construction. For this reason, it is now desired that the United States take over and complete the waterway. Interested parties point out that the $20,000,000 appropriated by the State constitutes a larger degree of cooperation than has been required of local interests by the United States in numerous other improvements of similar character.

POTENTIAL TONNAGE OF 7,500,000 TONS ANNUALLY.

8. The district engineer reports that a potential tonnage amounting to 7,500,000 tons annually would probably use this waterway if it were completed, and that to obtain such a link connecting the extensive Federal waterway systems of the Great Lakes and the Mississippi Valley the United States would be justified in expending $7,500,000 which he estimates to be the amount which will be required for the completion of the waterway after the State has expended the whole of its $20,000,000. He states that the waterway in general is well designed and well suited to serve its intended purpose, except that he believes that a depth of 9 feet should be provided and the small amount of additional dredging necessary to provide such a depth, even if the flow at Lockport is reduced to 1,000 cubic feet per second, has been included in his estimate. If the flow should be reduced below this amount, the necessary dredging would be somewhat increased, but the increase in cost would be relatively small. The district engineer also discusses certain proposed modifications of the plans in the neighborhood of

the city of Joliet, but concludes that no such modification is necessary at the present time.

RECOMMENDATIONS OF DISTRICT ENGINEER.

9. The district engineer recommends—

(a) That the authorized project for the improvement of the Illinois River below Starved Rock near Utica, be extended via the course of the Illinois River, Marseilles Canal, DesPlaines River, and thence modified so as to provide minimum 9-foot depths of the present width in the following existing canals and rivers: via the main Sanitary Canal to the west fork of the south branch of the Chicago River, and via the Sag Canal and the Little Calumet Rivers to turning basin No. 5, including all appurtenances and auxiliaries thereof useful and necessary for the purpose of navigation.

(b) That the unexpended and unobligated balance of the appropriation of $20,000,000 by the State of Illinois remain available for immediate expenditure under the direction of the Chief of Engineers and the Secretary of War in the completion of the unfinished works as planned by the State in the reach Starved Rock near Utica to the locks at Lockport, known as the Illinois State Waterway, and that no expense to the United States be incurred for the occupation of the rights of way pertaining to the Illinois Waterway or for the utilization of the completed and uncompleted locks and dams and other works of navigation on said waterway; that in order to expedite the completion of the waterway and its utilization for free navigation with a 9-foot depth between the Mississippi River System and the Great Lakes, the Chief of Engineers and the Secretary of War, if it be found advantageous to the United States to do so, may accept from the State of Illinois the uncompleted portions of current contracts and other valid obligations of the State, and may also accept or acquire such equipment, machinery or other things useful and necessary for the completion of the waterway or its subsequent operation as may have been purchased or ordered by the State for such purposes, it being understood that such taking over, acceptance or acquisition on quantum meruit basis is hereby specifically authorized, notwithstanding the requirements of existing law as to contract advertisement and competitive bidding; that the settlements in accordance with the spirit of this provision be subject to the approval of the Comptroller General of the United States; that the connected waterway thus effected by cooperation between the United States and the State of Illinois be recognized as navigable waters of the United States, and subject to the laws of the United States affecting navigable waters.

(c) That the sum of $7,500,000 be appropriated, and so much thereof as may be necessary, made available and expended at the pleasure and discretion of the Secretary of War by the Chief of Engineers for the completion of such waterway.

The division engineer concurs.

WASHINGTON ANALYSIS OF GOVERNOR'S LETTER.

10. The report of the district engineer has been referred, as required by law, to the Board of Engineers for Rivers and Harbors, and attention is invited to its report herewith. The board concurs in the opinions of the district and division engineers that it is advisable for the United States to undertake to complete this waterway, that the depth of the completed waterway should be nine feet, and that the construction should follow the general lines of the plans of the State of Illinois. While the normal method of securing this result would be to require the State to convey to the United States full title in the waterway, including both land and structures, the board is of the opinion that the long delay which such transfer would require justifies the adoption of another method. The board attaches to its report a letter from the Governor of the State of Illinois, containing certain proposals and assurances in connection with the completion of this waterway by the United States, and also attaches an opinion of the Attorney General of the United States relating to the legal points involved. In effect the Governor of the State of Illinois offers to complete the work on the bridges crossing

the waterway and to expend, under the supervision of the Secretary of War, the remaining portions of the State's waterway funds on work necessary to complete the waterway, upon the condition that the Federal Government will take over, complete and maintain, and operate the waterway. While admitting that he can not convey title to the waterway, its land or structures, the Governor says that the State will interpose no obstacle to the United States occupying and using the same, and contends that if the United States thus occupies and completes the waterway, it will become navigable water of the United States and will be and remain under the sole jurisdiction and control of the Federal Government as completely as if conveyance of title had been made, and that this jurisdiction and control will extend to and embrace all water power rights. On behalf of the State of Illinois, he disavows any intent or purpose to assert any claim to the contrary on condition that the Federal Government take over and complete the waterway. From the opinion of the Attorney General, it appears that the United States would have the right to do the various acts proposed and that on the completion of the waterway, it would have full power to regulate and control navigation thereon so as to insure to the public the free right of navigation and to prevent interference therewith, but that as regards those portions of the waterway which are entirely artificial the State can not, without its consent be deprived of the right to reasonable compensation for the use of its property or reasonable tolls for the passage of vessels. It further appears that no officers of the State have the authority to relinquish the State's rights in this respect. In order to insure that when the United States has completed this work a free public waterway shall be available from Lake Michigan to the Illinois River, the board considers that the State of Illinois should be required to dedicate as free public waterways any portions of the waterways between Utica and Lake Michigan which are entirely artificial. The board points out further that its recommendations are based on the premise, that, should Congress decide to adopt the project, the good faith of the State will be sufficient to protect the interests of the United States, extending to and embracing all water power rights claimed by the State of Illinois.

RECOMMENDATIONS OF BOARD OF ENGINEERS.

11. Based upon the proposals and assurances contained in the letter of the Governor of Illinois, and subject to the opinion of the Attorney General of the United States, previously referred to, the board recommends that the existing project for the improvement of the Illinois River be extended to provide a navigable depth of not less than nine feet with suitable widths from the head of the present Federal project near Utica, Ill., to the forebay of the power house of the Sanitary District of Chicago near Lockport, Ill., by means of dams, locks, lateral canals, and dredging in general accordance with the plans submitted by the State of Illinois and approved by the Secretary of War March 6, 1920, at an estimated cost to the United States of $7,500,000 with $223,000 annually for operation and maintenance: *Provided*, that the State of Illinois shall proceed, subject to the supervision and approval of all expenditures and obligations by the Secretary of War, to construct the highway bridges at the Brandon Road and Marseilles Canals, to make the necessary alterations in the other highway bridges, to make the necessary arrangements and agreements for the alteration of the railroad bridges, and to do such other work on the waterway as the Secretary of War shall direct and the available funds of the State will permit; the highway bridges mentioned not to become property of the United States and the United States not to incur any obligation to maintain, operate or replace them: *And, provided, further*, that no Federal funds shall be expended for the occupation of the lands, easements and rights of way of the Illinois Waterway, or for the utilization of the completed and uncompleted locks, dams and other navigation improvements in such waterway, or for any equipment procured by the State for the construction, operation, or maintenance of the waterway: *And, provided further*, that the State of Illinois shall by suitable action pronounce the system of waterways extending from the head of the present Federal project on the Illinois River to the heads of the present Federal projects on

the Chicago and Calumet Rivers to be free and unobstructed waterways forever dedicated to free public use for navigation.

CONCLUSIONS OF CHIEF OF U. S. ENGINEERS.

12. After due consideration of these various reports, I am of the opinion that there should be a Federal Waterway as the connecting link between the Mississippi River System of waterways and the Great Lakes system via the Illinois River, the DesPlaines River, the Chicago River and certain waterways improved or under improvement by the State of Illinois and the Sanitary District of Chicago or other political subdivisions of the State, and that such waterway should have a depth of nine feet. To this end, based on proposals and assurances contained in the letter of the Governor of Illinois, and subject to the opinion rendered by the Attorney General of the United States, I recommend that the existing project for the improvement of the Illinois River be extended to provide for a navigable depth of not less than nine feet from the head of the present Federal project on the Illinois River to the heads of the Federal projects on the Chicago and Calumet Rivers, the portion between Utica, Ill., and the forebay of the power house of the Sanitary District of Chicago near Lockport, Ill., to be secured by means of dams, locks, lateral canals and dredging, in general accordance with the present plans of the State of Illinois for the construction of the so-called Illinois Waterway, at an estimated cost to the United States of $7,500,000 with $223,000 annually for maintenance and operation, and the portions north and east from the forebay of said power house to be secured by utilization of the existing system of improved waterways constructed by the Sanitary District of Chicago in which depths now exist considerably in excess of nine feet, subject to the following provisions:

(a) That the project thus adopted shall be in all its parts a navigable waterway of the United States, forever free to the public use of all, unincumbered by any tolls or restrictions of any kind whatsoever except such as may be imposed by Congress.

(b) That the State of Illinois shall proceed subject to the supervision and approval of all expenditures and obligations by the Secretary of War, to construct the highway bridges at the Brandon Road and Marseilles Canal, to make the necessary alterations in other highway bridges across the Illinois Waterway, to make the necessary arrangements and agreements for the alterations of the railroad bridges across said waterway, and to do such other work on said waterway as the Secretary of War shall direct and the available funds of the State make possible; the bridges mentioned not to become the property of the United States, and no obligations to be incurred by the United States to maintain, operate or replace them.

(c) That no claim shall lie against the United States because of any contractural obligations which have been or may be entered into by the State of Illinois as regards the construction of a waterway between Utica and Lake Michigan.

13. As shown by the estimates prepared by the district engineer the nine-foot channel heretofore adopted by Congress can be secured by various flows of water, even as low as one thousand cubic feet per second. Decreasing the flow increases the dredging but not in any serious amount.

Very truly yours,

LYTLE BROWN,
Major General, Chief of Engineers.

REPORTS OF ENGINEER OFFICIALS.

Document No. 126, gives in complete detail the "Reports of the Board of Engineers for Rivers and Harbors" analyzing the "Re-examination of the Illinois and DesPlaines Rivers, (Ill.)" and the full report thereon by the District Engineer, First Chicago District, Lt. Col. W. C. Weeks, whose recommendations were concurred in by the Division Engineer, Lt. Col. Geo. R. Spalding of St. Louis, Missouri.

SECRETARY OF WAR AND ATTORNEY GENERAL.

Also included in said document is a letter from the Secretary of War, Patrick J. Hurley, to the Attorney General of the United States, concurred in by the President, requesting his advice as to "the legal consequences which would result from the Federal occupation of the Illinois State Waterway without amendment of the constitution of the State of Illinois," under which the State can not expend any money in excess of the $20,000,000 authorized by the amendment of 1908 on this project, and can not convey title to the right of way and real estate connected therewith to the United States. The opinion of the Attorney General, William D. Mitchell, addressed to the President, is printed in full, together with full text of the Illinois Waterway Act, of 1919, under which the State has been constructing the waterway; certain extracts from separate sections of the Illinois Constitution of 1870, now in force; descriptive details, original plans, etc., of the Illinois Waterway, submitted to the War Department in 1915; a resume of official action by the United States government; approval of plans; bridge table, etc. Lack of space precludes giving these reports in full.

LETTER FROM GOVERNOR EMMERSON.

In the report of the Chief of Engineers, quoted above, reference is made to "the proposals and assurances contained in the letter of the Governor of Illinois" a copy of which letter was attached to and made a part of the engineer report. The full text of said letter, dated March 19, 1930, is printed below:

Brief Transmitted With Letter Dated March 19, 1930.

From: The Governor of the State of Illinois, Louis L. Emmerson.
To: The Secretary of War for the United States, Hon. Patrick J. Hurley.
Subject: Suggestion to the Government of the United States in reference to that section of the proposed Federal Waterway from the Great Lakes at the port of Chicago to the Gulf of Mexico, commonly referred to as the Illinois Waterway.

The question of transportation was, as it still is, vital to the states and to the nation in the development of their resources. Faced with the necessity for adequate transportation facilities, the State of Illinois, as early as 1822, secured through Act of Congress, certain land grants and concessions for the location and construction of the Illinois and Michigan Canal. Not until after the Act of 1827 by Congress, granting further concessions, was it possible to finance the construction of the canal. The old canal was completed and opened in 1847 and, though only 48 feet in width and of 4 feet minimum depth, this canal for many years carried a large volume of commerce and contributed materially to the commercial and industrial development of the State. Due to its inadequate width and depth and to the further fact that it was later paralleled by railroads, it ceased, after many years, to carry heavy commerce:

Appreciating the needs for a more adequate canal for commerce and other purposes, the Legislature of Illinois in 1889 passed an Act creating the Sanitary District of Chicago and authorizing the district to construct the Ship and Sanitary Canal from a point on the Chicago River in the city of Chicago to Lockport. Subsequent extensions were made by improvement of the DesPlaines River. This canal has been completed at an actual expenditure by the Sanitary District of Chicago, including the cost of improving the Calumet-Sag Channel and the Calumet and Chicago Rivers, all under approval of the Federal Government, of $71,361,000. All waterways constructed and improved by the Sanitary District of Chicago are ample in size and depth

and immediately available to navigation, and constitute vital and necessary links in the proposed Federal Waterway from the Lakes to the Gulf.

In 1907 the General Assembly of Illinois, at the suggestion of the Governor, realizing the absolute necessity of improving and canalizing that part of the DesPlaines and Illinois Rivers between Lockport to a point near Utica on the Illinois River in Illinois, to afford connection for navigation from the Great Lakes to the navigable reaches of the Illinois River and thence to the Mississippi River near Grafton in the State of Illinois, submitted a $20,000,000 bond issue to referendum, as an amendment to the Constitution of Illinois. The amendment was adopted and the issuance of the bonds authorized. Several years' delay ensued, but finally active work on the five locks, the necessary dams, and the excavation for canalizing parts of the river comprising this natural link proceeded. It now has proceeded to the point where the necessary works are approximately three-fourths completed. The total amount vouchered for payment by the State of Illinois on this project to January 1, 1930, is $15,442,902.19. Estimated expenditures to July 1, 1930, being for maintenance and protection of present construction only, is $500,007.81. This leaves an estimated net balance on hand, as of July 1, 1930, of $4,142,000 (this includes $85,000 added to the original $20,000,000, which was realized from premiums on bond sales, etc.) Of this balance an estimated amount of $2,730,000 will be required to build 10 bridges over the new waterway, which bridges were made necessary by the construction of said waterway and constitute a part of the cost incidental thereto. They can only be constructed out of funds authorized by vote of the People under the Constitution of the State of Illinois. The State must, therefore, and does reserve this sum of $2,730,000 out of the original bond issue funds to construct said bridges, which will leave an estimated balance of approximately $1,412,000 remaining in said Illinois Waterway Fund, control thereof by appropriate Act of Congress or by other constituted authority.

The State of Illinois has provided by constitutional enactment that no canal or waterway of the State may be sold or leased without referendum. This limitation appears in the following amendment to the Constitution of Illinois, adopted in 1908:

"The Illinois and Michigan Canal, or other canal or waterway owned by the State shall never be sold or leased until the specific proposition for the sale or lease thereof shall first have been submitted to a vote of the People of the State at a general election, and have been approved by a majority of all the votes polled at such election. The General Assembly shall never loan the credit of the State or make appropriations from the treasury thereof in aid of railroads or canals: *Provided*, that any surplus earnings of any canal, waterway, or water-power may be appropriated or pledged for its enlargement, maintenance, or extension: *And, provided, further* that the General Assembly may, by suitable legislation, provide for the construction of a deep waterway or canal from the present water-power plant of the Sanitary District of Chicago, at or near Lockport, in the township of Lockport, in the county of Will, to a point in the Illinois River at or near Utica, which may be practical for a general plan and scheme of deep waterway along a route, which may be deemed most advantageous for such plan of deep waterway; and for the erection, equipment, and maintenance of power plants, locks, bridges, dams, and appliances sufficient and suitable for the development and utilization of the water-power thereof; and authorize the issue from time to time, of bonds of this State in a total amount not to exceed $20,000,000 which shall draw interest, payable semi-annually, at a rate not to exceed 4 per cent per annum, the proceeds whereof may be applied as the General Assembly may provide, in the construction of said waterway and in the erection, equipment, and maintenance of said power plants, locks, bridges, dams, and appliances.

"All power developed from said waterway may be leased in part or in whole, as the General Assembly may by law provide; but in the event of any lease being so executed, the rental specified therein for water-power shall be subject to a revaluation each 10 years of the term created, and the income therefrom shall be paid into the treasury of the State."

It is my opinion and judgment, however, under the authority of *Wisconsin* v. *Duluth* (96 U. S. 379), that upon adoption of the Illinois Waterway by the Federal Government, and upon an appropriation being made for its completion, the Federal Government will acquire as full and complete jurisdiction and control of said waterway and its necessary appurtenances, as if, by appropriate authority, conveyance of title had been made by the State of Illinois. This is clear from the following language appearing on pages 386-388 of the opinion in *Wisconsin* v. *Duluth*:

"We do not feel called upon to make an argument to prove that these statutes of the Congress of the United States, and these acts of the Executive Department in carrying those statutes into effect, constitute an adoption of the canal and harbor improvement started by the city of Duluth, and a taking exclusive charge and control of it. That they amount to the declaration of the Federal Government, that we here interpose and assert our power. We take upon ourselves the burden of this improvement, which properly belongs to us, and that hereafter this work for the public good is in our hands and subject to our control.

"If the merest recital of these Acts of Congress, and of the War Department under them, do not establish that proposition, we can have little hope of making it plain by elaborate argument.

"Nor can there be any doubt that such action is within the constitutional power of Congress. It is a power which has been exercised ever since the government was organized under the Constitution. The only question ever raised has been how far and under what circumstances the exercise of the power is exclusive of its exercise by the states. And while this court has maintained, in many cases, the right of the states to authorize structures in and over the navigable waters of the states, which may either impede or improve their navigation, in the absence of any action of the general government in the same matter, the doctrine has been laid down with unvarying uniformity, that when Congress has, by any expression of its will, occupied the field, that action was conclusive of any right to the contrary asserted under state authority. The adjudged cases in this court on this point are numerous.

"This subject was recently very fully considered in *South Carolina* v. *Georgia et al.* (93 U. S. 4), and at this term in *Pound* v. *Turk* (95 *id.* 459). The doctrine was settled, however, long before this. The following cases are fully in point: *Gibbons* v. *Ogden* (9 Wheat 1); *Wilson et al.* v. *The Blackbird Creek Marsh Co.* (2 Pet. 245); *The Wheeling Bridge Case* (18 How. 421); *Gilman* v. *Philadelphia* (3 Wall. 713).

"If, then, Congress, in the exercise of a lawful authority, has adopted and is carrying out a system of harbor improvements at Duluth, this court can have no lawful authority to forbid the work. If that body sees fit to provide a way by which the great commerce of the lakes and the countries west of them, even to Asia, shall be securely accommodated at the harbor of Duluth by this short canal of 300 or 400 feet, can this court decree that it must forever pursue the old channel, by the natural outlet, over water too shallow for large vessels, unsafe for small ones, and by a longer and much more tedious route?

"When Congress appropriates $10,000 to improve, protect and secure this canal, this court can have no power to require it to be filled up and obstructed. While the engineering officers of the government are, under the authority of Congress, doing all they can to make this canal useful to commerce, and to keep it in good condition, this court can owe no duty to a state which requires it to order the city of Duluth to destroy it.

"These views show conclusively that the state of Wisconsin is not entitled to the relief asked by her bill, and that it must, therefore, be dismissed with costs."

On behalf of the State of Illinois I disavow here and hereafter any claim or claims to the contrary, on condition, however, that the Federal Government do adopt and complete said waterway section and appropriate moneys to defray the cost thereof, as may be required in excess of the remaining balances in the Illinois Waterway fund, as hereinbefore indicated,

the State reserving therefrom the amounts required for bridge construction work specified, and for necessary and required expenditures by the State from such funds for the protection, maintenance, or prosecution of said work, until such time as the Federal Government may assume control thereof by appropriate act of Congress, or by other constituted authority.

In view of the national importance of the proposed waterway from the Great Lakes to the Gulf, with connections afforded with other reaches of the proposed system of inland waterways, and of the vital necessity for completing and opening for navigation the so-called Illinois Waterway section hereinbefore described, and in consideration of the dedication to the Federal Government and the nation for free use for navigation in said inland waterway, of the useful and usable construction provided by the State of Illinois and the Sanitary District of Chicago, at a joint expense of over $90,000,000, a cost which the Government of the United States would have had to assume in order to open said waterway had the construction hereinbefore referred to not been carried to its present state of completion by the State of Illinois, and in view of the further fact that the State of Illinois is without sufficient balances in its bond issue waterway fund to complete the Illinois Waterway and can not appropriate additional funds for that purpose, except by constitutional amendment, a slow and uncertain process, and in view also of the fact that said waterway, when completed, will be a national highway for water-borne commerce of the nation, I respectfully urge, on behalf of the State of Illinois, that the Federal Government do, without delay, by appropriate act of Congress, authorize the adoption and federalization of the whole of said waterway, and appropriate for, and authorize its immediate completion by the Federal Government.

I have refrained from devoting space to the story of the interest evinced by the Federal Government, during nearly a century, in the ultimate development of the Illinois Waterway from the Lakes to the Mississippi River and of the surveys made in connection therewith, and of the appropriations for the improvement of the Illinois River, as they are matters of record and only tend to evidence the recognition of the whole development as a Federal project, to which the State of Illinois and the Sanitary District of Chicago have made substantial contributions.

All of which is respectfully submitted.

LOUIS L. EMMERSON,
Governor of the State of Illinois.

ESTIMATES OF TOTAL COST.

There was submitted with the Governor's letter the following summarized estimate of total cost, prepared by this division as of October 1, 1929, printed as "Appendix I" in Bulletin 126.

There was also submitted, as "Appendix I-A," a War Department estimate, of "Funds required to complete the unfinished structures of the Illinois Waterway." They show a difference of about $1,600,000 due to Federal estimates being based upon a larger amount of dredging than contemplated by State plans.

These estimates were shown as follows:

APPENDIX I.

Summary—Estimate of total cost, October 1, 1929. (State Engineers.)

LOCKPORT LOCK.

Contract 4–A.	Excavation, masonry and upper gates, etc. (completed)	$1,435,142.50
Contract 4–D.	Miter gates and valves (completed)	209,390.51
Contract 8.	Machinery	47,089.61
	Removing cofferdam	4,999.95
	Cement	212,000.00
Contract 12.	Electrical fixtures	59,582.55
	Permanent buildings	4,770.00
	Total	$1,972,975.12

Waterway Between Lockport and Brandon Road.

Contract 6.	Retaining walls, sewers, etc.	$2,384,124.31
	Contractors fee	238,412.40
	Cement	441,000.00
	Engineering, 6 per cent	183,812.22
	Total	$3,247,348.93

Brandon Road Lock and Dam.

Contract 5.	Lock and dam, fee cost	$2,785,016.37
Contract 8.	Machinery	73,996.56
Contract 10.	Miter gates, valves, and Taintor gates	523,471.73
Contract 12.	Electrical fixtures	39,663.34
	Permanent buildings	90,100.00
	Total	$3,512,248.00

Waterway Between Brandon Road and Dresden Island.

Contract 9–D 1 and 2		
	Dredging	$ 339,500.00
	Engineering, 2.7 per cent	9,166.50
	Total	$ 348,666.50

Dresden Island Lock and Dam.

Contract 3.	Lock, dam, excavation, masonry, etc. (including gravel)	$1,378,000.00
Contract 8.	Machinery	73,996.56
Contract 10.	Miter gates, valves, and Taintor gates	615,226.12
	Cement	227,000.00
Contract 12.	Electrical fixtures	41,454.91
	Permanent buildings	29,786.00
	Total	$2,365,463.59

Waterway Between Dresden Island and Marseilles Dam.

Contract 9–C 1.	Dredging	$ 264,386.96
Contract 9–C 2.	Dredging equipment	338,219.41
	Total	$ 602,606.37

Marseilles Dam.

Contract 9–C 2.	Excavation, masonry. Taintor gates and machinery, etc.	$ 430,000.00
	Engineering, 6 per cent	25,800.00
	Total	$ 455,800.00

Marseilles Canal.

Contract 9–B.	Excavation	$ 904,696.18
	Engineering, 3.6 per cent	32,569.06
	Total	$ 937,265.24

Marseilles Lock.

Contract 1.	Masonry, excavation, etc. (completed)	$1,345,441.02
Contract 4–D.	Gates and valves (completed)	273,221.99
Contract 8.	Machinery	73,996.56
Contract 12.	Electrical fixtures	46,507.85
	Permanent buildings	31,164.00
	Total	$1,770,331.42

Waterway Between Marseilles Lock and Starved Rock Lock and Dam.

Contract 9a 1 and 2	$ 582,878.70
Engineering, 4.75 per cent	27,686.74
Total	$ 610,565.44

Starved Rock Lock and Dam.

Contract 2.	Lock and dam, excavation, masonry, etc.	$2,265,396.21
Contract 7.	Miter gates, valves, and Taintor gates	818,947.73
Contract 8.	Machinery	73,996.56
Contract 12.	Electrical fixtures	41,331.32
	Permanent buildings	37,418.00
	Total	$3,237,089.82

Five Scherzer rolling lift bridges, Joliet	$1,445,000.00
Plans for same	100,000.00
Settlement with owners of other than public bridges	750,000.00
Building movable spans for public bridges between Joliet and Starved Rock	875,000.00
Rebuilding approaches to bridges	150,000.00
Bridges over Marseilles and Brandon Road canals	170,000.00
Engineering, 6 per cent	203,000.00
Bridges, total	$3,693,000.00
Embankments and levees	$ 300,000.00
Engineering, 5 per cent	15,000.00
Total estimated cost	$ 315,000.00
Right of way purchased and damage claims pertaining thereto settled	$1,812,506.25
Right of way unpurchased and damage claims pertaining thereto for future settlement	587,493.75
Engineering and miscellaneous, 1.2 per cent	28,587.00
Land and land damages, total	$2,428,587.00
Estimated total cost	$25,496,947.43

APPENDIX I-A.

Funds required to complete the unfinished structures of navigation in the Illinois waterway section of the route Illinois River to Lake Michigan as estimated by the district engineer.

Item No.	Designation	Amount
1.	State appropriation	$20,000,000.00
2.	Estimate of total cost (State engineers)	25,496,947.00

3.	Expended and obligated (Dec. 1, 1929)	$15,019,474.00
4.	Estimated expenditure in December, 1929	535,000.00
5.	Total estimated, expended, and obligated, Jan. 1, 1930, item 3 plus item 4	$15,554,474.00
6.	Total required to complete after Jan. 1, 1930, State plan and estimate, item 2 less item 5	$ 9,942,473.00
7.	Balance of State appropriation available for expenditure Jan. 1, 1930, item 1 less item 5	4,445,526.00
8.	Amount required to complete waterway, State plan and estimate, item 6 less item 7	$ 5,496,947.00
9.	Add for additional dredging in Illinois waterway section (see par. 40, this report)	428,100.00
10.	Add for engineering emergencies, contingencies, and overhead 20 per cent of item 8 plus item 9	1,185,010.00
11.	Total estimated amount over and above unexpended and unobligated State funds Jan. 1, 1930, item 8 plus item 9 plus item 10	$ 7,110,057.00

NOTE.—The amount $7,110,057, is that estimated by the district engineer as necessary to complete the unfinished structures of navigation built by the State of Illinois in the Illinois and DesPlaines Rivers, including the Marseilles Canal, in the reach Starved Rock near Utica—locks at Lockport, known as the Illinois State Waterway. It a so includes the cost of additional dredging considered necessary.

The estimate is based on the assumption that the unexpended and unobligated balance of the State appropriation, which is $4,445,526, will remain available and be expended in the completion of the waterway.

DELAYS DEPLETE AVAILABLE FUNDS.

As previously pointed out, the Rivers and Harbors Act of 1930 was passed so late in the session that no part of the "authorized appropriation" of $7,500,000 of Federal funds will be available until actually appropriated at the session of Congress which opens next December.

The War Department having no funds available for immediate use in taking over the Illinois Waterway, it has been necessary for the State to continue in possession, maintaining structures, and completing certain work, which it had been expected the Federal Government would care for, according to the State's contractural obligations and legal responsibilities. This has tended to deplete the State Waterway fund far below the estimate of October 1, 1929.

On the other hand it should be borne in mind that all these expenditures by the State, in excess of the original understanding, have brought completion of the Illinois Waterway so much nearer.

AMENDMENT TO ILLINOIS WATERWAY ACT.

A special session of the Fifty-sixth General Assembly was held, pursuant to call of the Governor, from May 12 to June 25, 1930.

At said special session, section 27 of the Illinois Waterway Act was amended, so as to provide that the proceeds from the sale of machinery, tools, equipment and other personal property acquired by the State for the construction of the Illinois Waterway and no longer needed for that purpose, should be covered into the fund known as "The Waterway Fund."

The entire section as amended now reads as follows:

Sec. 27. The gross or total proceeds, receipts and income arising from the operation, management and maintenance of "The Illinois Waterway" and its appurtenances, including all receipts from the utilization or lease of water power, shall be covered into a special fund in the treasury which shall be known as "The Waterway Maintenance Fund."

The proceeds from the sale of machinery, tools, equipment and other personal property acquired for the construction of the Illinois Waterway and no longer needed for that purpose, shall be covered into the special fund known as "The Waterway Fund." Approved June 27, 1930. (Smith-Hurd, p. 236.)

This amendment should be supplemented by a further provision authorizing the sale of real property heretofore acquired for waterway purposes and no longer needed. Authority should also be granted to the Director of Purchases and Construction to deal with the Illinois Waterway tunnel situation at Joliet.

HIGH OFFICIALS INSPECT WATERWAY.

The Illinois Waterway moved into the national picture in the summer of 1929, when the late Secretary of War, James W. Good, and Governor Louis L. Emmerson, as guests of the Illinois Manufacturers' Association, made a two-day tour of inspection of this connecting link between the Great Lakes system and the Mississippi River system of inland waterways.

READY FOR WATERWAY INSPECTION TRIP.

Left to right: J. D. Cunningham, president, Illinois Manufacturers' Association; H. W. Elmore, president, Sanitary District of Chicago; James W. Good, Secretary of War; Louis L. Emmerson, Governor of Illinois; Ruth Hanna McCormick, Congresswoman, and daughter; Wm. R. Dawes, president, Mississippi Valley Association; M. L. Igoe, legislator; Chas. S. Deneen, U. S. Senator; Lawrence Heyworth; David E. Shanahan, Legislator; L. D. Cornish, chief engineer, and Wm. F. Mulvihill, supervisor of Illinois Waterway Construction.

FROM CHICAGO TO PEORIA.

The weather was ideal. The party consisted of representatives of the commercial and manufacturing interests of the State, headed by J. D. Cunningham, president of the Illinois Manufacturers Association,

and many important public officials, including the Secretary of War, Governor Emmerson, Lieutenant Governor F. E. Sterling, the Director of this department, Henry H. Kohn, and other State officials, members of Congress from Illinois, members of the Illinois General Assembly, Federal and State engineers, officials of the Sanitary District of Chicago, newspaper men and others.

At Lockport where the Chicago Sanitary and Ship Canal connects with the Illinois Waterway. (P. & A. Photo.)

1. Col. Robert I. Randolph, President Chicago Association of Commerce.
2. David E. Shanahan, Speaker, Illinois House of Representatives.
3. Hon. James W. Good, Secretary of War.
4. Congressman Wm. E. Hull of Peoria.
5. H. W. Elmore, President, Sanitary District of Chicago.
6. Wm. F. Mulvihill, Supervisor of Illinois Waterway Construction.
7. Hon. Louis L. Emmerson, Governor of Illinois.
8. Senator Geo. M. Reynolds, of Utica.
9. Hon. Chas. S. Deneen, U. S. Senator.
10. Senator Richard J. Barr, of Joliet.

INSPECT CONNECTING WATERS.

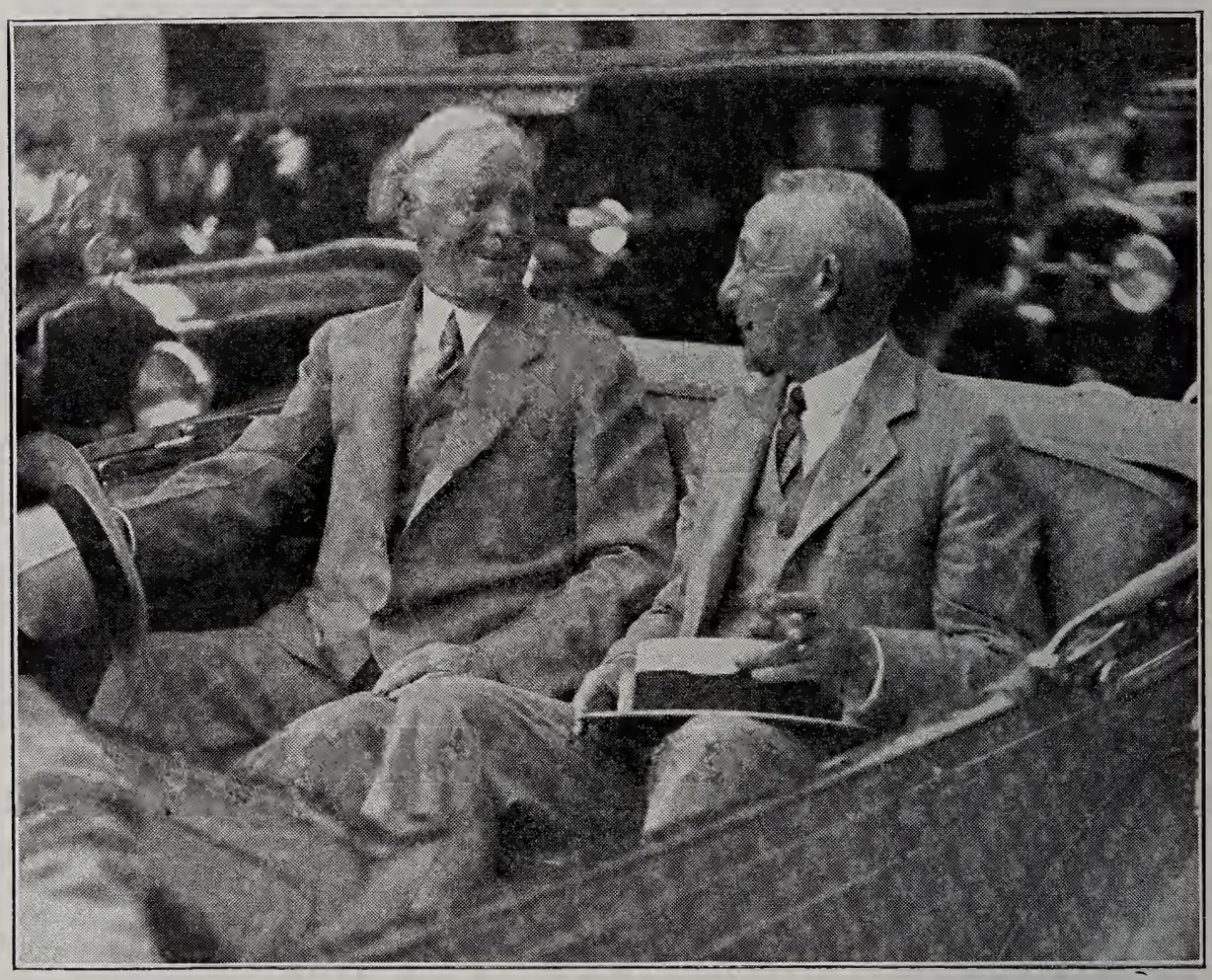
The inspection included a trip by boat through the reaches of the Chicago River, the current of which was reversed in 1900, and now flows away from Lake Michigan, the channel of the Chicago Sanitary and Ship Canal, to Lockport, where the sanitary channel connects with the DesPlaines River.

It was pointed out to the Secretary of War, en route, that certain expenditures of the Sanitary District of Chicago, which would be of benefit to navigation, amount to over $65,000,000, for improvement of the Chicago and Calumet Rivers and construction of the Main and

Calumet Sag Channels, which have since been approved as Federal projects, in extending the navigability of the Illinois River to Lake Michigan.

VIEW SITES OF FUTURE INDUSTRY.

Leaving Chicago about 8:30 in the morning, daylight saving time, August 27, 1929, the 35 mile boat trip to Lockport—through the canal which cut the back-bone of the continental divide and placed the City of Chicago in the Mississippi watershed—gave the party a first hand view of the potential development of manufacturing plants on both banks of the canal, which completion of the Lakes-to-the-Gulf Waterway will tend to promote.



WAITING FOR THE PARADE TO START.
An intimate picture of Secretary of War Good and Governor Emmerson, while inspecting the Illinois Waterway, preliminary to its being adopted as a Federal Project. (Chicago Daily News Photo.)

LUNCHEON AT JOLIET.

After an inspection of the completed Lockport lock, and the power plant of the Sanitary District of Chicago, a short ride and automobile parade, as guests of the local manufacturing interests, concluded with a luncheon at the Chamber of Commerce building in Joliet.

From Joliet to Dresden Island the trip was by automobile, with inspection of the retaining walls and lock and dam of the Brandon Road pool, immediately after luncheon.

BOATING BELOW DRESDEN.

At Dresden Island the party divided into two groups, Federal and State officials and Mr. Cunningham taking fast motor boats down the river 24 miles to Marseilles, with inspection of the State's 3 yard dipper dredge "Louis L. Emmerson" and other floating equipment and the completed Marseilles lock as objectives; while the rest of the party travelled by barge and tow-boat to Morris, from whence they were transported to LaSalle, where the reunited visitors were guests at a banquet attended by delegates from many municipalities in the Illinois Valley.

MASSIVE CONCRETE CONSTRUCTION.

Secretary Good and Governor Emmerson viewing Illinois Waterway Work at Brandon Road Lock and Dam, near Joliet. When ready for navigation 30 feet of water will cover the location of the automobile in which the Secretary of War and Governor are standing. Col. Fred Bennitt is seated in the car. (P. & A. Photo.)

OVERNIGHT STOP AT LA SALLE.

At the evening meeting addresses were made by the Secretary of War, Governor Emmerson, and Hon. C. A. Newton of St. Louis, general counsel for the Mississippi Valley Association, and former chairman of the so-called "Waterway bloc" in Congress, later held by Congressman W. E. Hull of Peoria.

PROMISES EARLY COMPLETION.

Speaking at Joliet and LaSalle, and later at Peoria, Governor Emmerson, among other things said:

"The lakes to gulf waterway is going to be completed during the present administration in Illinois. Neither the Federal government nor the State of Illinois government can afford delaying the completion of this monumental project. We are going to complete the waterway and on its completion we are going to see the building of the greatest industrial district in any state. The waterways will be lined with great industries. This is the most essential business now before the State. The $20,000,000 voted by the State has proved inadequate, and five million dollars or more is needed. We have never asked help. But we expect to get it without asking. I don't believe the government is going to hold back this 63-mile waterway link from being opened to the world."

GOOD STRESSES WATERWAY BENEFITS.

Secretary of War Good laid stress upon the benefits to midwest agriculture and industry to be derived from the completion of the Waterway, saying:

"Our agricultural communities are going to be served and benefited by the development of the inland waterways more than any other one cause.

HAUL HEAVY COMMODITIES.

"We are going to haul heavy commodities at a reduced rate. The difference between those rates and the present rates will spell the difference between loss to the farmer and gain to the farmer.

"When the United States and the State projects have been completed, a nine foot channel will exist from Chicago to St. Louis, New Orleans and Pittsburgh, connecting with seven foot projects on the Allegheny and Monongahela rivers and with six foot channels extending up the Missouri River to Sioux City and the upper Mississippi to Minneapolis and St. Paul. To the upper Mississippi the Illinois and Mississippi canal gives a shorter route with a depth of 7 feet from LaSalle to the Mississippi at Rock Island.

"Furthermore, at New Orleans, this great waterway system connects with the intercoastal waterway and thus has access to Galveston, Houston and Corpus Christi to the west, and Mobile and Birmingham to the east, while an extension to Pensacola is contemplated."

FURNISH OUTLET FOR GRAIN.

"This will furnish an outlet for the grain, ore, iron and steel products of the lakes district and open up the Illinois markets to the coal of the Ohio River district and the oil, sugar, sulphur, lumber and other products of the Gulf states.

"It will facilitate the general interchange of raw materials and manufactured products between Illinois and the important industrial centers previously mentioned. It is estimated that if suitable terminal facilities are provided an annual movement in excess of 7 million tons will make use of the waterway."

NEWTON SEES EAST FIGHT PROJECT.

Mr. Newton, taking up the legislation deemed essential from Congress to give formal recognition to the Waterway and the necessary diversion from Lake Michigan for navigation, a question left open by the Supreme Court decision denying diversion for sewage dilution, dwelt on the formidable array of business and finance lining up in the east against the project.

"There will be the opposition," Mr. Newton said, "of the great power interests which want the water to turn the turbines in the St. Lawrence.

"It behooves the middle west to unite, get a survey of this project and put it in as part of the river and harbor bill next winter. Wisconsin, Michigan, and Minnesota stand to profit as much by this development as Illinois and Chicago. The middle west should understand it should prepare for formidable opposition from the east."

At the Joliet luncheon Senator Richard J. Barr, acted as toastmaster. Col. Fred Bennitt was chairman of the reception committee. Mayor George F. Sehring and others spoke briefly.

At LaSalle the mayors of the "Tri-Cities"—Mayor Joseph Brzygot of LaSalle, Mayor Albert Haase of Peru and Mayor Charles Spurr of Oglesby—extended the welcome of the section to the distinguished visitors.

HEADWATERS OF "THE DIVINE ILLINOIS."

A group of business men and public officials passing under the E. J. & E. railroad bridge at "Divine," just below Dresden Island, where the Kankakee and DesPlaines rivers unite to form the Illinois. (Chicago Daily News, photo.)

GUESTS OF HONOR PLEASED.

After a day floating down the water from Chicago with some stretches covered by automobile, both the guests of honor at night declared themselves greatly impressed with the physical evidences of what the State has done in construction work.

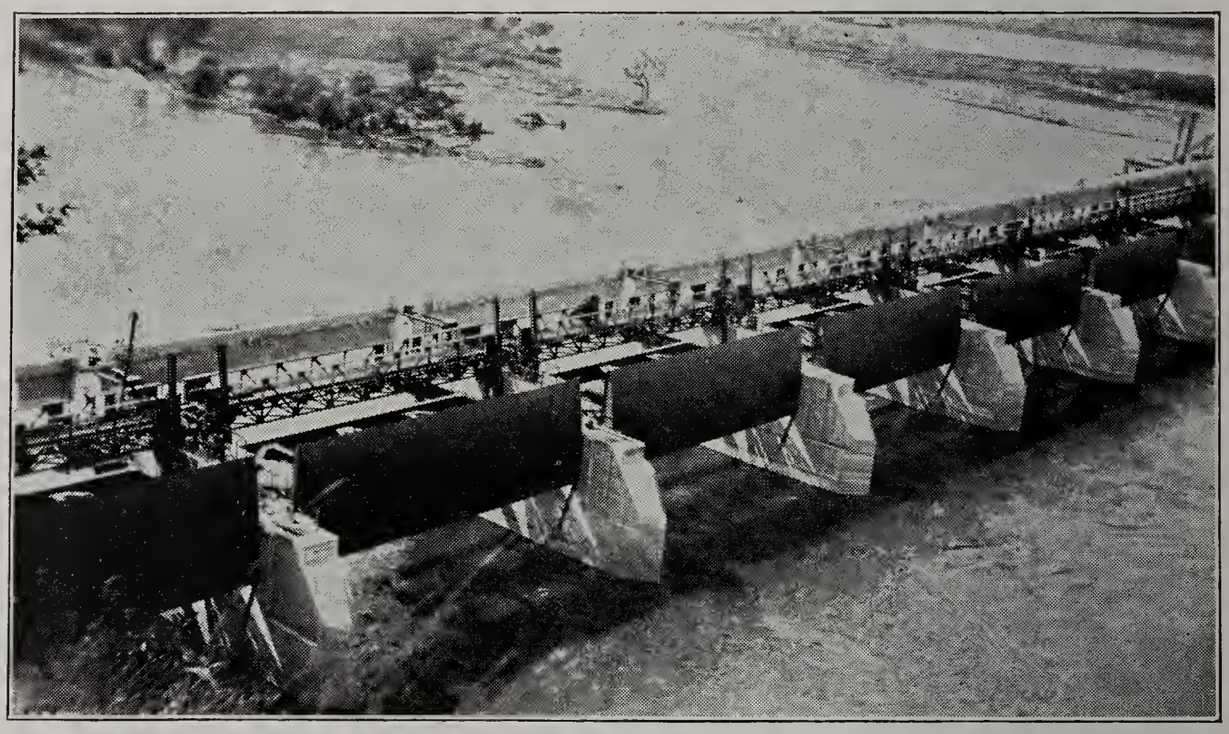
All day long the party traveled over stretches of waterway either already completed or well under way. They found towering cliffs of concrete embankments, thousands of feet of dam construction, great

dredges scooping up the mud from the channel and lock structures at points along the river surrounded by construction camps.

VIEW VAST COFFERDAM.

At Dresden Island the tour led to the vast cofferdam which the State has built, exposing the bed of the river for the construction of a lock. All these visible evidences that the State project is fast on its way to completion, with the State now spending over $500,000 a month on work it is doing itself, in addition to the projects let to the contractors, led Secretary Good to remark:

"Our check up by the army engineers this spring showed the Illinois Waterway about 45 per cent completed, but it looks to me from what we have seen today to be more than 55 per cent finished. Governor Emmerson and I have been deeply impressed by what we have seen today, and the magnitude of the operations by the State."



Portion of dam at Starved Rock. Consists of series of concrete piers with steel gates which are raised or lowered in order to regulate depth of water above dam. These are known as Taintor gates after their inventor, and are the largest ever constructed.

SEE STARVED ROCK LOCK AND DAM.

After a night's rest at LaSalle, the party motored to Starved Rock Park for inspection of the Starved Rock lock and dam, which had been passed the night before on account of darkness.

This inspection was made from watercraft which was able to pass between the gigantic concrete piers which anchor the mammoth movable steel Taintor gates, to form the dam and which will control the water-level above the structure.

GUESTS OF UNCLE SAM.

From Starved Rock lock and dam, by auto, to Peru was a short trip. There the party boarded the U. S. S. Comanche, for Peoria, where reception, dinner by the Yacht Club and public rally in the

evening ended an interesting and instructive tour which seems destined to have great influence upon the taking over of the Illinois Waterway and the Chicago Sanitary District's Main and Calumet Sag Channels as approved Federal projects.

TOUR ENDS IN UNDERSTANDING.

On the boat trip down the river, between Peru and Peoria, conferences were held, between the Governor, Secretary of War, Senator Charles S. Deneen, members of Congress, State legislators, and public officials, bankers, business men and commercial leaders of the State.

As a result a committee was named to investigate the situation as to constitutional and political difficulties and to confer with Attorney General Oscar E. Carlstrom, the attorney for the Sanitary District of Chicago and the Attorney General of the United States in relation thereto. Said committee consists of Senator Deneen and Congressmen Henry T. Rainey, Edward E. Denison and Frank R. Reid.

LEGAL QUESTIONS INVOLVED.

The task of the committee involves consideration and determination as to the legal powers of Illinois to finish the financing of the stretch from Lockport to Utica, and the details, obligations and commitments which would be involved if the State decided to turn the Waterway over to the Federal Government.

For the first time since the discovery of the State's financial limitations and handicaps, there seemed to be a clear understanding of what the problems are, and with that understanding, came the agreement to let a committee work out with Governor Emmerson the line of policy. That result, it is agreed, makes a success of the trip which the Illinois Manufacturers' Association arranged and handled with care and efficiency, in conjunction with State and Federal officials.

WATERWAYS DIVISION SUBMITS FACTS.

In connection with the trip of inspection the Division of Waterways not only cooperated with the Illinois Manufacturers' Association in arranging the itinerary and caring for the comfort of the visitors, but also prepared a special illustrated brochure of "Illinois Waterway Facts" for the use of Secretary of War James W. Good, Governor Louis L. Emmerson and the Director of the Department, Hon. Henry H. Kohn.

This 58 page, 9x13 inch, morocco bound booklet, contained hand-illuminated drawings of the seven principal sections of the work, with maps and profile drawings of all locks and dams; aeroplane photographs of the same locations, (which are reproduced in this report) with six pages of general and engineering data, regarding the size, character and progress made toward completion of the project by the State, including a list of those accepting the invitation of the Manufacturers' Association to participate in the "Trip of Inspection."

PRESIDENT HOOVER GETS COPY.

During the progress of the trip it was suggested to the Supervisor of Illinois Waterway Construction, by the Secretary of War, that if the former would have an additional copy made of this illustrated booklet

the latter would see that the same was personally delivered to President Hoover, which was done accordingly.

The following letters of acknowledgement are presented:

War Department,
Washington, *September 18, 1929.*

Dear Mr. Mulvihill:

I have received the illustrated copy of data regarding the Illinois Waterway and it has been my pleasure to present it to the President for his consideration.

Sincerely yours,
(Signed) James W. Good,
Secretary of War.

Mr. William F. Mulvihill,
Supervisor Illinois Waterway Construction,
220 South State Street,
Chicago, Illinois.

The White House,
Washington, *September 19, 1929.*

My Dear Mr. Mulvihill:

Secretary Good has presented to the President the illustrated copy of data regarding the Illinois Waterway which you were good enough to forward to him.

The President appreciates your courtesy in sending this data to him.

Sincerely yours,
(Signed) George Akerson,
Secretary to the President.

Mr. William F. Mulvihill,
Supervisor,
Illinois Waterway Construction,
Chicago, Illinois.

SUMMARY OF FACTS SUBMITTED.

The facts submitted to the members of the party of inspection, included the following, which are published here for their generally informative value:

"THE ILLINOIS WATERWAY."

The Connecting Link Between the Great Lakes and Mississippi Valley Systems of Inland Waterways.

Under Construction by
THE STATE OF ILLINOIS.

Louis L. Emmerson, *Governor.*
Henry H. Kohn, *Director, Department of Purchases and Construction.*
Wm. F. Mulvihill, *Supervisor of Illinois Waterway Construction.*
Lorenzo D. Cornish, *Chief Engineer, Division of Waterways.*

General Data.

August 27-28, 1929.

Extent: Lockport to Starved Rock Lock, near Utica, Ill.

Length: 60 miles.

Total Drop: 139 ft.

Locks:

Chambers 110 ft. wide x 600 ft. long; total length 925 ft.
Depth on miter sill—14 ft.
Upper and lower approach walls each 600 ft. long.
Capacity for navigation—9,000 tons.

Lock Gates:

Mitering type, 6 leaves at each lock; 4 upper leaves to constitute one operating and one emergency gate; 2 lower leaves for lower operating gate.

(At Lockport, the lower gate is of the mitering type but the upper operating and emergency gates are of the vertical lift type.)

Dams:

The typical dams for Starved Rock and Dresden Island, consist of Taintor gates, head gates for possible power houses 500 ft. long; ice chute and earth embankment.

At Marseilles, the dam consists of Taintor gates and ice chute with earth embankment and concrete core wall.

At Brandon Road, the dam consists of an ogee concrete spillway 1,350 ft. long, 6 sluice ways, ice chute, headgates for power house 500 ft. long and embankment with concrete core wall.

Pools:

Brandon Road Pool, length 6 miles.
Dresden Island Pool, length 14 miles.
Marseilles Pool, length 24 miles.
Marseilles Canal, length 2½ miles.
Starved Rock Pool, length 13½ miles.

Channels:

9 ft. depth in earth, 10 ft. in rock, 200 ft. width.

Quantities:

Excavation—Total all jobs, 3,887,000 cu. yds.
Concrete—Total all jobs, 715,320 cu. yds.
Steel and iron—Total all jobs, 9,795 tons.

Costs:

Estimated cost, $25,000,000.00.
Bond issue (authorized in 1908), $20,000,000.00.
Needed to complete, $5,000,000.00.

General Information.

Locks:

Culverts: Openings 12 feet in diameter extending lengthwise through the lock walls connected directly with the lock chamber, through small lateral rectangular openings, spaced so as to eliminate surge of the water on the barges. The flow through these culverts is controlled by four valves each weighing 4½ tons.

Mechanical System: The high stresses taken by the gears for operating the miter gates required extra high grade or manganese steel and particularly careful design. The bull-wheel operating the strut for moving the miter gate leaf is 19 feet in diameter and weighs 11 tons.

Electrical System: All gates, valves, capstans, lighting and signals are operated electrically. A dual control system is used. The length of electric cable necessary for this system is about 7 miles for each lock.

Location of Locks and Dams.

Location.

The locations of the locks and dams, with differences in water levels of the upper and lower pools are:

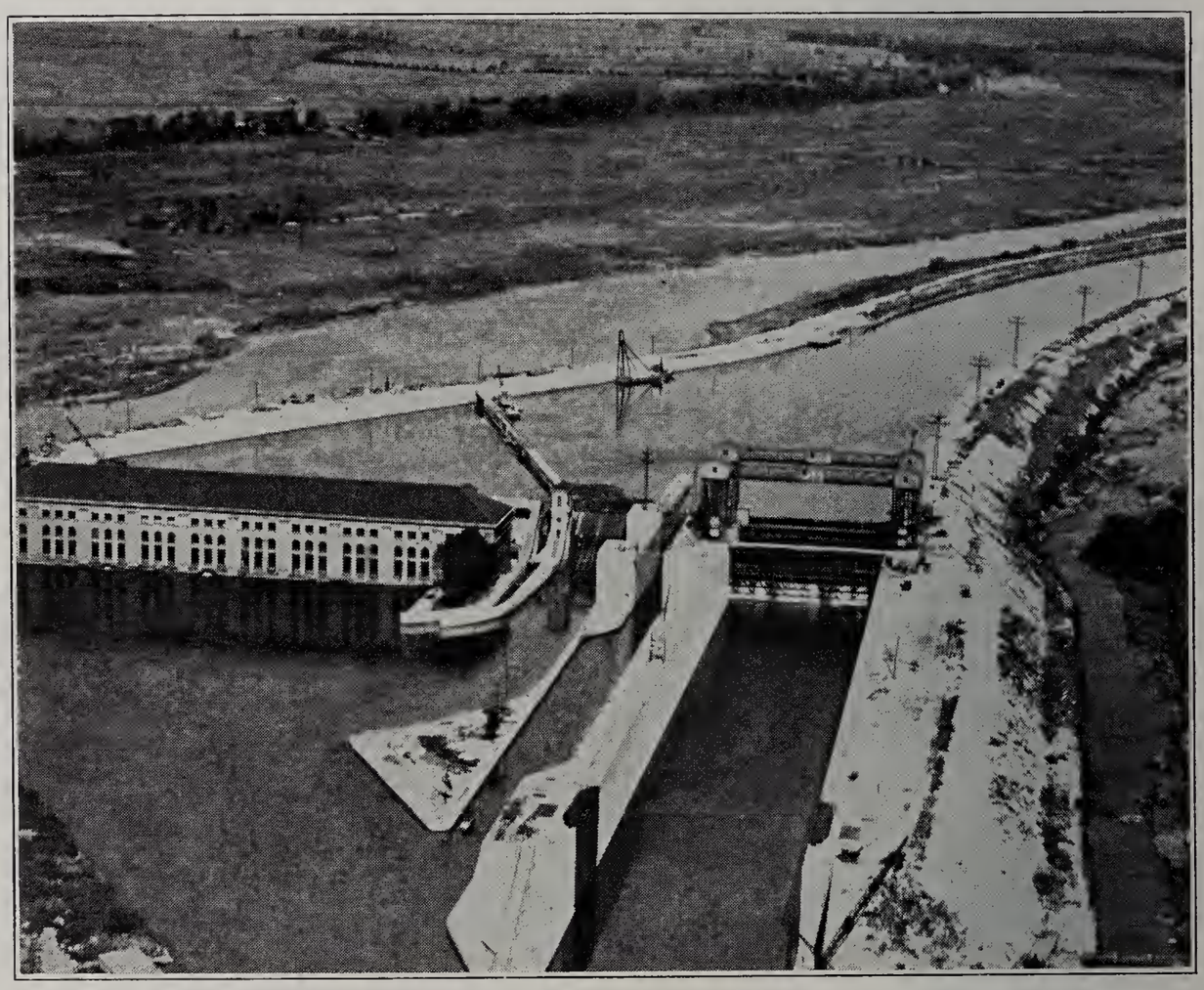
No.	Name and Location.	Lift.
1.	Lockport, 35 miles from Chicago (Connects Chicago Sanitary and Ship Canal with the Des-Plaines River.)	41 feet
2.	Brandon Road, 2 miles below Joliet	31 feet
3.	Dresden Island, 14 miles downstream	17 feet
4.	Marseilles, 3 miles below town	21 feet
5.	Starved Rock, between Ottawa and Utica	16 feet

Total distance, 60 miles; fall, 139 feet; downstream slope, 13 feet; combined lift of locks, 126 feet.

Connecting Waterways.

The Chicago Sanitary and Ship Canal extends from Chicago to Lockport. It is 35 miles long, 21 feet deep, 160 feet wide. It connects Lake Michigan with The Illinois Waterway. It constitutes the summit level of the Lakes to Gulf Waterway, and has cost the people of Chicago $75,000,000.

The Federal Government is improving the Illinois River to 9 feet depth, from the lower end of the Illinois Waterway to the Mississippi River.



Aeroplane view of Lock No. 1 of The Illinois Waterway located at Lockport, Illinois. This lock, like the four others of the series is 110 feet wide, 600 feet long with 14 feet of water over the miter sills. It has a lift of 41 feet. It connects the Chicago Sanitary and Ship Canal with the DesPlaines River, about 35 miles from Chicago and Lake Michigan. The building at the left is a Power House. During the past year the operating machinery has been installed, tested, and approved as satisfactory. Photo by Chicago Aerial Survey Co.

Construction Data and Estimates.

Project.	Cost.	Excavation, cu. yds.	Concrete, cu. yds.	Steel and iron, tons.	Per cent complete.
Lockport Lock	$1,923,000	148,280	91,220	1,480	98
Brandon Road Pool (excluding bridges)	2,912,000	235,000	190,440	1,030	47
Brandon Road Lock and Dam	3,384,000	294,000	150,560	1,710	----------
Dresden Island Lock and Dam	2,251,000	155,000	98,000	1,850	20
Marseilles Dam	452,000	8,000	11,200	525	----------
Marseilles Lock	1,772,800	226,650	61,300	850	95
Marseilles Canal	631,000	1,133,000	----------	----------	57
Starved Rock	2,852,000	482,000	112,600	2,350	84
Channel Improvement	1,252,000	1,205,000	----------	----------	5
Bridges, right of way and miscellaneous	7,570,200	----------	----------	----------	----------

Facts of Interest.

Lockport Lock.

Upper gates are vertical lift type. Height 20 feet. Weight 190 tons each. Lower lock gates 60 feet high are mitering type, two leaves, each weighing 315 tons.

An emergency dam hydraulically operated is located in the floor of the upper lock gate chamber. It weighs 50 tons. A shutter dam, weighing 75 tons, is located in the lower lock gate chamber. These are for use in case of damage to lock gates.

This lock chamber is the largest of the series. It can be filled or emptied in 12 minutes.

Aeroplane view of the Brandon Road Pool of The Illinois Waterway through the city of Joliet. The old Illinois and Michigan Canal is shown at the right running parallel with the DesPlaines River. McDonough Street Bridge is shown in the left foreground. Concrete retaining walls from 18 feet to 45 feet high are under construction on both sides of the Pool. Construction to the extent of $650,000.00 was done during the last year. The Lock and Dam construction and Brandon's Bridge, two miles below the city, appear in the middle distance. Photo by Chicago Aerial Survey Co.

Brandon Road Pool

In the DesPlaines River. Extends from Lockport Lock to Brandon Road Lock. The construction includes one main standard lock with 31 feet lift; one junction lock with the Illinois and Michigan Canal; earth embankment with concrete core wall.

The upper lock gates are 20 feet high; the lower gates are 50 feet high.

The dam includes retaining walls 2,000 feet long, ice chutes of 30 feet span; head gate structures for possible power house 500 feet in length; 6 sluice gates with openings 6 x 8 feet; ogee spillway dam 1,350 feet in length and 40 feet high; 21 Taintor gates, (which are movable allowing regulation of pool levels above the dam), with piers at top of ogee spillway, each of

50 feet span; 22 foot bridges of 50 feet span over the Taintor gates and ice chute.

Retaining Walls: Concrete retaining walls extend upstream from the dam on both sides of the river. The east wall varies in height between 40 and 15 feet. Length 2⅓ miles. The west wall has a height of 23 feet and length 1.8 miles. These walls are hollow at the base for the entire length to act as intercepting sewers for the city of Joliet. Size of sewers at outlets, 8½ x 12 feet.

Utilities Tunnel: Sixty-five feet below pool elevation has been constructed through solid rock 350 feet to carry water and gas mains, telephone and electric power cables under the DesPlaines River.

Transfer of water mains from bridges to the tunnel necessitated relaying 3⅓ miles of water pipe.

Aeroplane view of Lock No. 2 of The Illinois Waterway. Located at Brandon Road, two miles below the city of Joliet. This lock will have a lift of 31 feet. A small junction lock of the Illinois and Michigan Canal is shown with concrete core wall extending to the Waterway lock. The water above the dam will be raised 31 feet, making the junction lock necessary to connect the old canal with the new level. Construction work on this lock and dam amounted to $650,000.00 for the year. Photo by Chicago Aerial Survey Co.

Turning Basin: The water will be raised about 31 feet at the lower end of this pool, which will be one-third of a mile wide.

Dresden Island Lock and Dam.

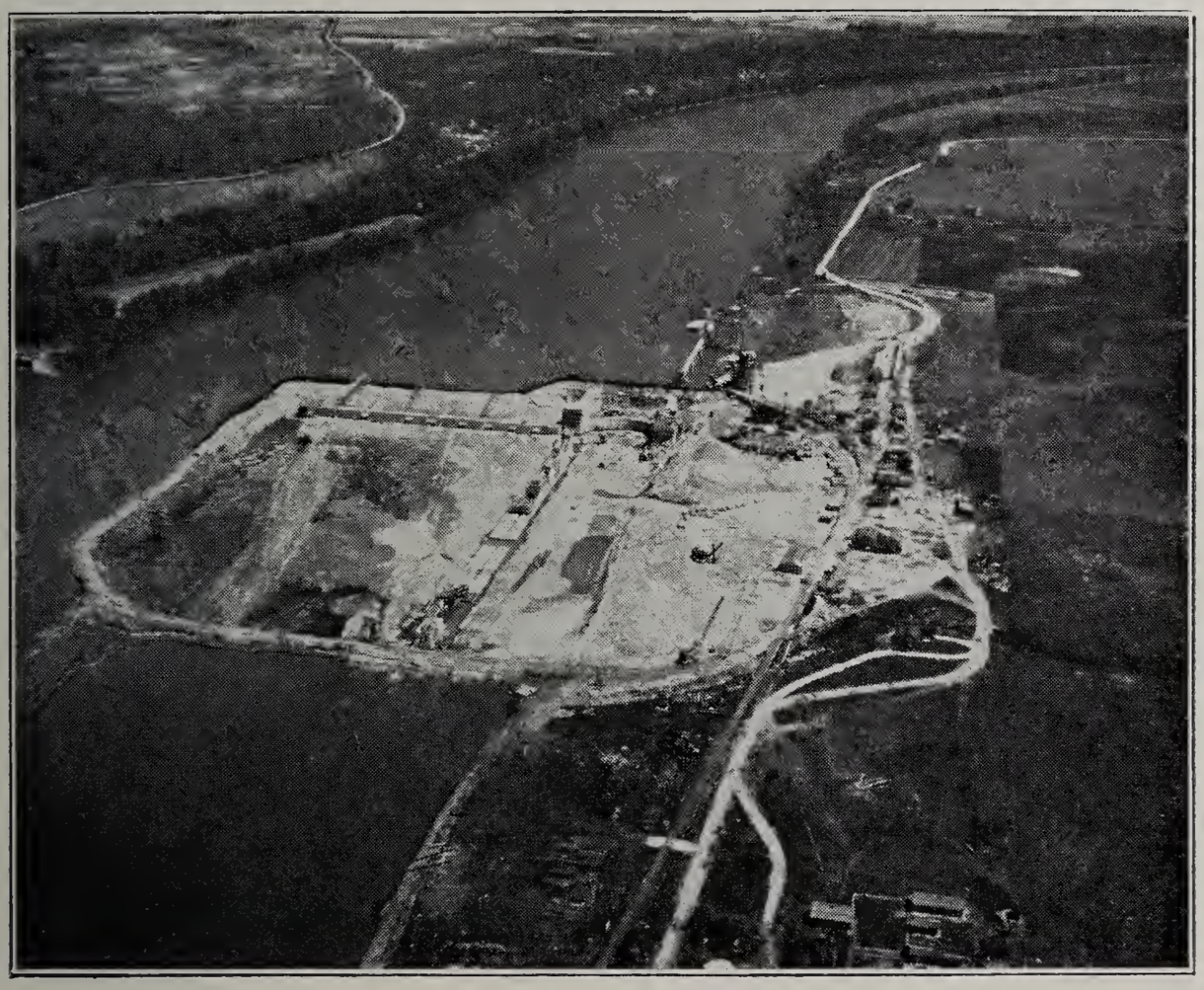
In the Illinois River a short distance below the confluence of the Kankakee and DesPlaines rivers. Construction includes one standard lock with lift of 17 feet. Time of filling lock chamber 7½ minutes. Earth embankment; retaining walls, head gates for possible power house; 9 Taintor gates with piers and ogee spillway dam with span of 60 feet each; ice chute 30 feet span. Height of upper lock gates 20 feet, lower lock gates 37 feet.

Marseilles Dam.

A new dam is to be constructed about 175 feet below the present dam which is privately owned and used for power development purposes.

The new construction will include earth dam with concrete core wall 500 feet long; 7 Taintor gates with 60 feet span between piers; ice chute of 30 feet span.

Entrance from the river to Marseilles Canal will be at south end of proposed dam.



Aeroplane view of site for Lock and Dam No. 3 of The Illinois Waterway. Located in the Illinois River at Dresden Island, a short distance below the confluence of the Kankakee and DesPlaines rivers which unite to form the Illinois. On this lock and dam $524,585.00 in work was completed during the year. Photo by Chicago Aerial Co.

Marseilles Lock.

Is located 13,000 feet downstream from the Marseilles Dam. This lock is standard in horizontal dimensions and is located at the junction of the west end of the Marseilles Canal and the Illinois River. Lift 21 feet; time of filling 8½ minutes.

Starved Rock Lock and Dam.

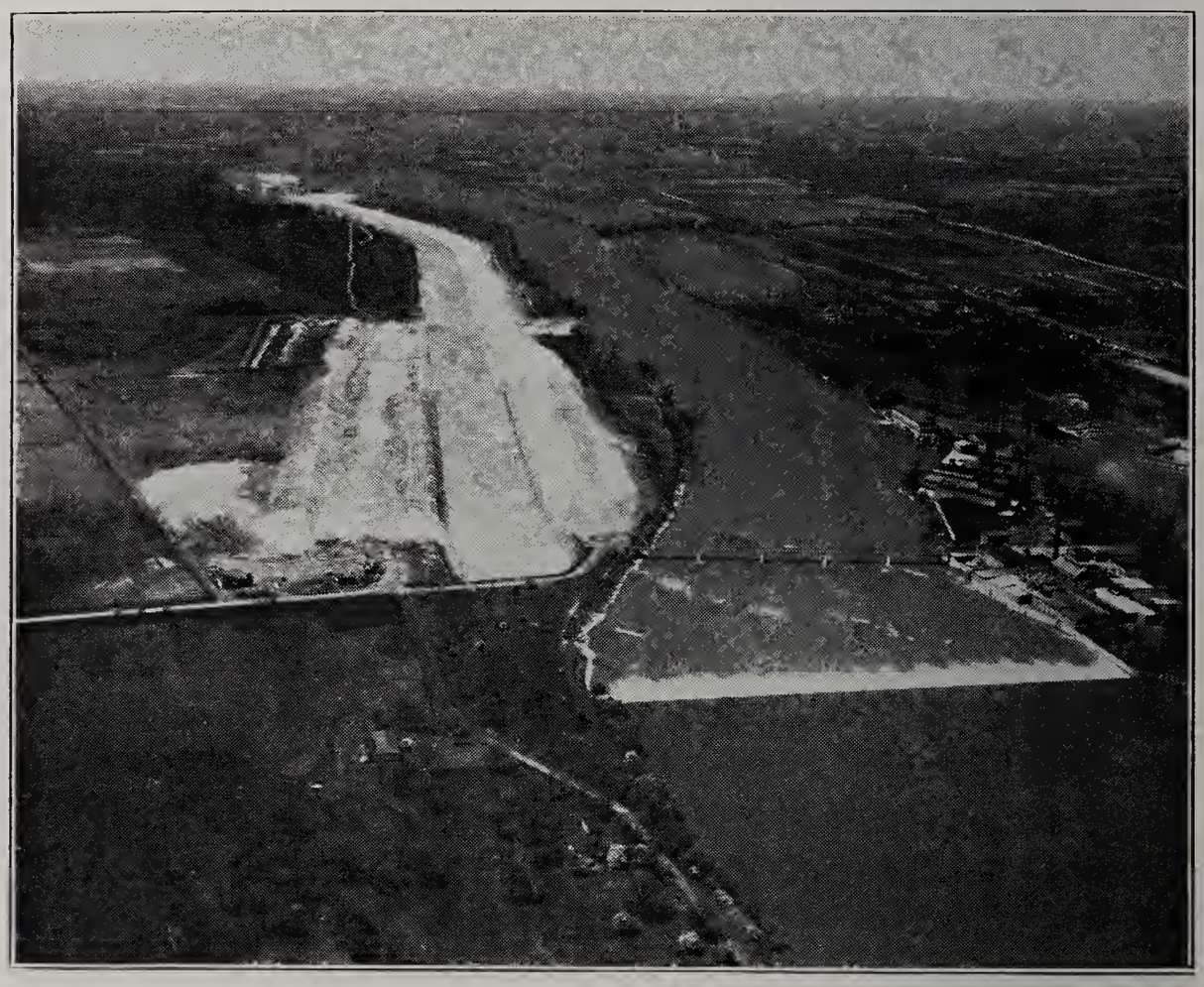
This standard lock has a lift of 16 feet, time of filling or emptying lock chamber 7¼ minutes.

Construction includes earth embankment 2,100 feet in length; 30 foot ice chute; head gate structures for possible power house 500 feet and 10 Taintor gates of 60 feet span each.

Note: These Taintor gates are designed to stand a height of 19 feet of water and are the largest ever constructed. The weight of one gate with its counterweight is about 200 tons.

Right of Way.

This involves about 6,000 acres of land, which includes sites for locks, dams and other waterway structures; the greater part, is land which will be inundated when the dams are completed and water levels raised in the various pools. All structure sites and about two-thirds of the other lands needed have been acquired.



Marseilles Canal of the Illinois Waterway. Aeroplane picture showing crest of present dam across the river. The Canal, which is 13,000 feet long, will extend from the river above the dam shown in the picture to connect with the Marseilles Lock which is dimly shown in the distance. This canal has been completed during the past year. Photo by Chicago Aerial Survey Co.

List of Those Accepting the Invitation of
THE ILLINOIS MANUFACTURERS' ASSOCIATION
"Waterway Inspection Trip" August 27-28, 1929.

Hon. James W. Good, Secretary of War, Washington, D. C.
Hon. Louis L. Emmerson, Governor of Illinois, Springfield.
Hon. Fred E. Sterling, Lieutenant Governor, Springfield.

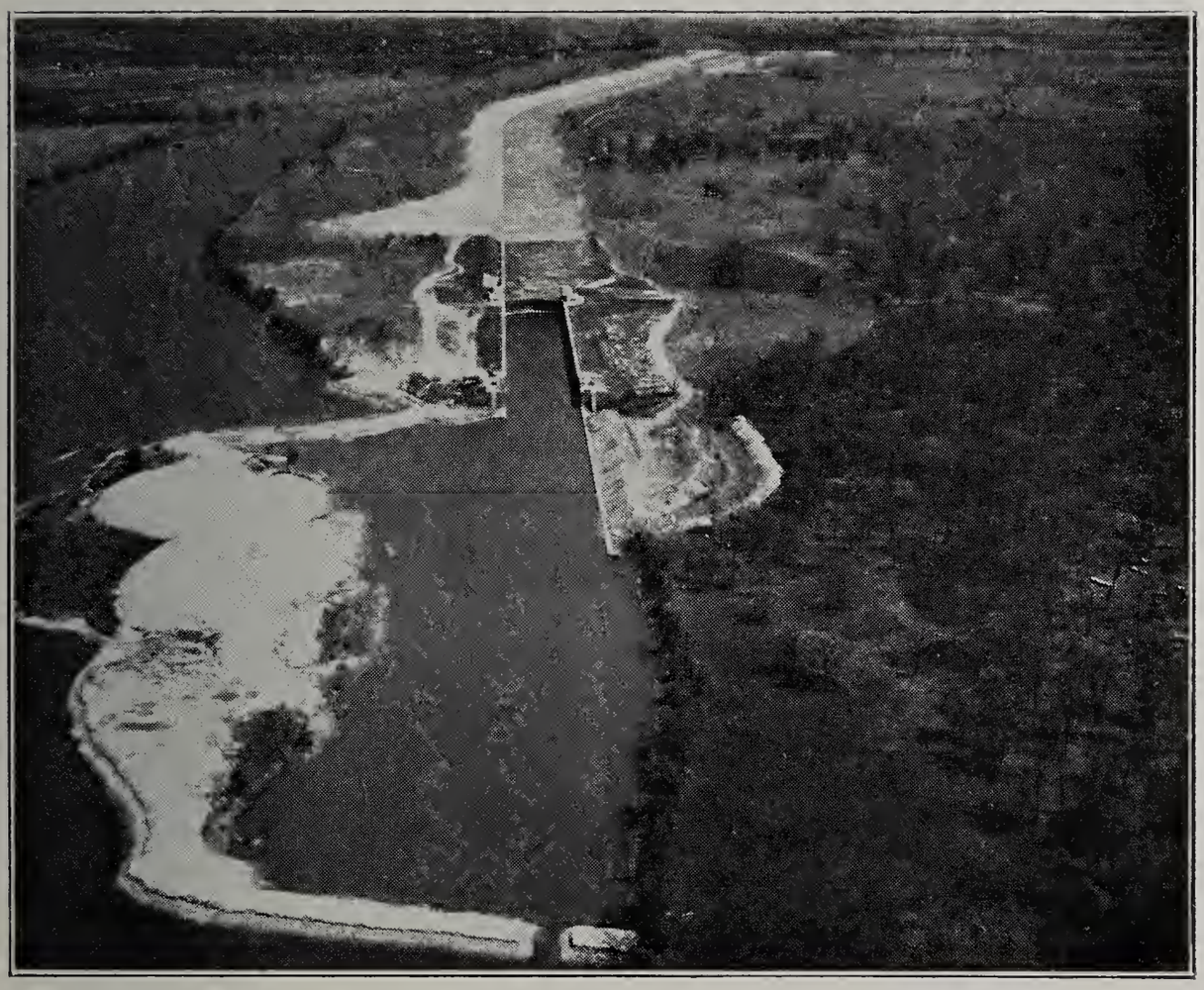
ILLINOIS DELEGATION IN CONGRESS.

Senator Charles S. Deneen, Chicago.
Hon. Charles Adkins, Decatur.
Hon. John C. Allen, Monmouth.
Hon. John T. Buckbee, Rockford.
Hon. Edward E. Denison, Marion.
Hon. William E. Hull, Peoria.
Hon. Ruth Hanna McCormick, Byron.
Hon. M. A. Michaelson, Chicago.
Hon. Henry T. Rainey, Carrollton.
Hon. Frank M. Ramey, Hillsboro.
Hon. Frank R. Reid, Aurora.

MEMBERS OF ILLINOIS GENERAL ASSEMBLY.

Senators.

Hon. Richard J. Barr, Joliet.
Hon. Martin R. Carlson, Moline.
Hon. Simon E. Lantz, Congerville.
Hon. Victor P. Michel, Peoria.
Hon. George M. Reynolds, Utica.



Aeroplane view of Lock No. 4 of The Illinois Waterway. Located two and one-half miles below the city of Marseilles. A canal 200 feet wide completed during the year, will connect this lock with the river above the new dam to be built by the United States.

Representatives.

Hon. David E. Shanahan, Chicago.
Hon. Michael L. Igoe, Chicago.
Hon. Roger F. Little, Champaign.

E. M. Antrim, Chicago Tribune, Chicago.

Walter E. Beebe, General Counsel, The Sanitary District of Chicago.

O. M. Benson, Secretary, Illinois Valley Manufacturers' Association, LaSalle.

Theodore Brent, Traffic Counsel, Illinois Division of Waterways; President, Redwood Steamship Line.

Scott Brown, President, Illinois Chamber of Commerce, Chicago.

Mr. Carroll, Ottawa Chamber of Commerce, Ottawa.

David Clarke of Fyffe and Clarke, Counsel for the Illinois Manufacturers' Association.

Harry Cleaveland, Director, Department of Public Works and Buildings, Springfield.

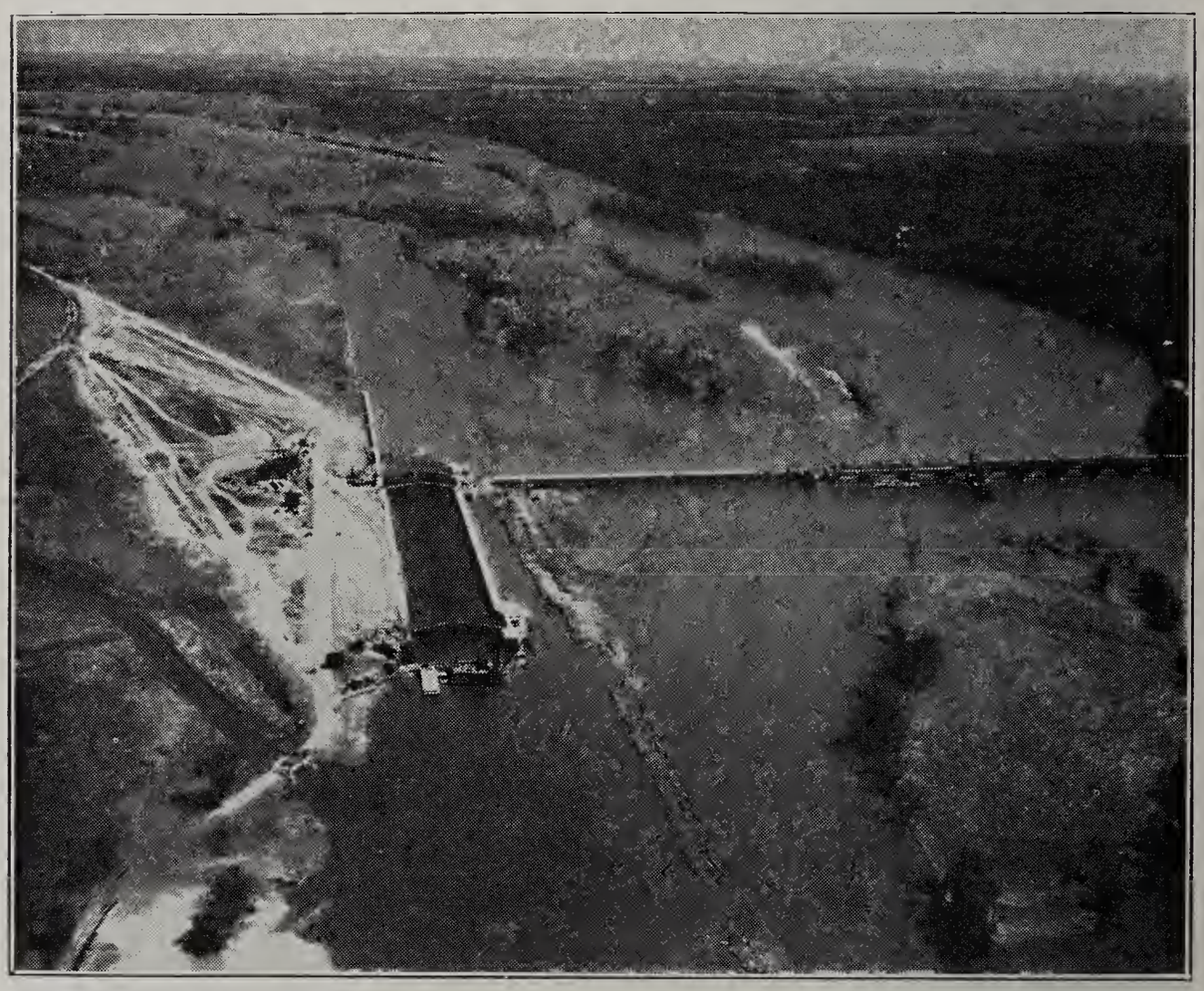
L. D. Cornish, Chief Engineer of Illinois Division of Waterways.

James D. Cunningham, President, Illinois Manufacturers' Association; Republic Flow Meters Company, Chicago.

I. F. Dains, Western Stoneware Company, Monmouth.

William R. Dawes, President, Mississippi Valley Association, St. Louis.

James L. Donnelly, Executive Vice President, Illinois Manufacturers'



Aeroplane view of Lock No. 5 of The Illinois Waterway. Located opposite historic Starved Rock. This lock is about 100 miles distant from Lake Michigan. It is the last of the series built by the State of Illinois. Below this point the Federal Government is dredging to provide a nine foot channel to the Mississippi. Woods Bros. Construction Co., of Lincoln, Nebraska, masonry contractors on this job, and the Independent Bridge Co. of Pittsburgh, Pa., steel contractors, completed their work during the past year.

Association, Chicago.

Howard W. Elmore, President, The Sanitary District of Chicago.

Arthur Evans, Chicago Tribune, Chicago.

Ray W. Flaherty, Peoria Journal and Peoria Transcript.

Theodore R. Gerlach, Gerlach-Barklow Company, Joliet.

John J. Glenn, Publisher, Manufacturers' News, Chicago.

Homer J. Guck, Chicago Herald and Examiner.

O. Gullicksen, Churchill Cabinet Company, Chicago.

E. T. Harris, Payson Manufacturing Company, Chicago.

Samuel M. Hastings, Dayton Scale Company, Chicago.

J. P. Haynes, Executive Vice-President, Chicago Association of Commerce.

W. F. Hetman, Assistant Director, Department of Purchases and Construction, Springfield.

Lawrence Heyworth, Congress Construction Company, Chicago.

R. H. Hippleheuser, Associated Press, Chicago.

E. N. Hurley, Electric Household Utilities Corporation, Chicago.

A. A. Judd, Chicago Journal of Commerce.

Lyon Karr, President, Illinois Bankers Association, Chicago.

W. K. Kavanaugh, Chairman, River Committee, St. Louis Chamber of Commerce.
Major General Roy D. Keehn, Chicago.
Donald Kirkpatrick, General Counsel, Illinois Agricultural Association, Chicago.
Henry H. Kohn, Director of Purchases and Construction, Springfield.
Bailey LaPorte, Lieutenant Marine Corps.
Charles LaPorte, Vice President, Keystone Steel & Wire Co., Peoria.
Charles A. Livingston, Publicity Director, Illinois Manufacturers' Association, Chicago.
Lachlan Macleay, Secretary, Mississippi Valley Association, St. Louis.
Alexander McKay, President, Matthiessen & Hegeler Zinc Company, LaSalle.
William F. Mulvihill, Supervisor of Illinois Waterway Construction, Chicago.
Cleveland A. Newton, General Counsel, Mississippi Valley Association, St. Louis.
Major General Frank Parker, Commanding General, 6th Corps Area, Chicago.
Charles Piez, Link Belt Company, Chicago.
Claude O. Pike, Chicago Daily News, Chicago.
John T. Pirie, Carson, Pirie, Scott & Company, Chicago.
Col. Robert Isham Randolph, Chicago.
L. E. Roarke, Secretary, Peoria Manufacturers' & Merchants' Association, Peoria.
Col. Edward H. Schulz, Cleveland, Ohio.
Earl C. Smith, President, Illinois Agricultural Association, Chicago.
William H. Stuart, Chicago Evening American, Chicago.
Ray Wantz, Rockford Fibre Container Company, Rockford, Ill.
Harold Watson, Administrative Auditor, Springfield.
Lt. Col. W. C. Weeks, Chicago.
E. C. Westman, Blomgren Brothers and Company, Chicago.
A. H. Wilkinson, Collector of Internal Revenue, Milwaukee, Wis.
George Williams, Williams Sealing Corporation, Decatur, Ill.
H. L. Williamson, Secretary, Illinois Press Association, Springfield.
Mark Woods, Woods Brothers Company, Lincoln, Nebraska.

ENGINEERING REPORT.

By L. D. Cornish, *Chief Engineer.*

THE ILLINOIS WATERWAY.

The marked increase in the activities of the engineering department in the construction of The Illinois Waterway, which began in 1926, continued to increase through 1927 and 1928, and culminated on December 31, 1929, on account of the necessity of curtailing expenditures from the Waterway Fund, pending the receipt of Federal aid for completing the work for which the Waterway Fund would not be sufficient. No new contracts were let during the fiscal year.

CONTRACTS OF EMPLOYMENT CANCELLED.

The progress on the work of the lock and dam at Brandon Road and retaining walls through Joliet, and also the construction of the Dresden Island lock and dam, was entirely within the control of the department, owing to the fact that the Division was constructing these projects by the direct employment of labor, materials and equipment.

On January 14, 1930, the superintendents of construction for this work were directed to discontinue forthwith all further activities, aside

from essential emergent work, and on June 4 they were formally served notice that their contracts of employment would terminate July 5, 1930. Compliance with these orders necessarily prevented the completion of concrete masonry required to permit of the installation of miter gates, valves and machinery and consequently prevented the installation and erection of metal work under contracts for such work at Brandon Road and Dresden Island.

Five non-cancellable contracts were in force, the work under which was not materially curtailed by the contractors on account of the extra cost to them consequential upon a curtailment program.

CONSTRUCTION WORK FOR FISCAL YEAR.

During the fiscal year the waterway construction work accomplished included 153,000 cubic yards of concrete, 1,170,000 cubic yards of excavation and embankment, and 3,305 tons of metal work and machinery received and partly erected.

Contracts have not been let for the electric lighting system nor for the buildings at any of the locks. Keeping this fact in mind the progress of construction on and status of completion of The Illinois Waterway during the year ending June 30, 1930 may be briefly summarized as follows:

LOCKPORT LOCK.

Existing sanitary district dams maintain the drainage canal levels to Lake Michigan. The machinery was installed in the last fiscal year but the testing of same and final acceptance was made on September 13, 1929. The lock is now completed and ready for operation after removal of existing cofferdams which removal probably will not be made until after the removal by dredges of the thick deposits of sludge in the Chicago Sanitary District canal immediately above the lock.

BRANDON ROAD—JOLIET POOL.

The high level channel of this pool is to be maintained by concrete retaining walls which were 44 per cent completed on June 30, 1929. Rapid progress on these walls was continued to December 31, 1929. This work was 68 per cent completed on June 30, 1930. For further details see report of R. S. Heath, Division Engineer.

Five movable bridges will be required to replace existing fixed bridges. Single leaf rolling lift bridges providing 5 feet clearance between water surface and low steel of bridge when down were agreed to between the State and the city of Joliet officials several years ago.

The Chief of Engineers, U. S. A., refused to approve permits for such low vertical clearance and the matter has been under adjustment during the entire year. Applications for permits have been filed with revised plans for higher bridges, which provide 16½ feet vertical clearances with the approaches on a 7 per cent grade. The additional cost, including property damage, due to these changes will amount to about $250,000. The U. S. District Engineer held a hearing in Joliet in June, at which considerable opposition to the heights and grades was registered by the citizens of Joliet. The matter is now in the hands of the United States War Department.

STATE WATER SURVEY DIVISION
Library Copy

A Federal permit dated November 26, 1929, for the Jefferson Street Bridge, Joliet with vertical clearance of 9½ feet and 5% approach grades has been received.

LOCK AND DAM AT BRANDON ROAD.

The masonry of the lock and upper approach walls is 99 per cent completed, the upper gates have been erected and very satisfactory progress on the construction of the dam was made up to December 31, 1929. The masonry and excavation work, as a whole, is about 72 per cent completed on June 30, 1930. For further particulars see the report of R. S. Heath, Division Engineer.

LOCK AND DAM AT DRESDEN ISLAND.

Rapid progress was continued on this work until January 14, 1930 when work was discontinued on account of prospective shortage of State funds. The concrete masonry is 25 per cent and excavation and embankments about 64 per cent completed on a physical basis, and the job, as a whole, 60 per cent completed on the fee cost basis of the existing personal service contract, which excluded the cost of cement and steel work. This contract was cancelled effective July 5, 1930.

On this work the State operated its own gravel pit. A royalty of 12 cents per cubic yard of gravel taken was paid the owners. During the year 30,000 cubic yards was delivered at the mixing plant for a total cost to the State of 72 cents per cubic yard. The gravel for Brandon Road lock cost $2.03, and for Starved Rock lock and dam from $2.07 to $2.16 per cubic yard. The economy of the State operated pit is so obvious that further comment would be superfluous. The excellent quality of the gravel is shown in the report of W. M. Smith, Assistant Chief Engineer, and further details of construction work in the report of J. B. Bassett, Division Engineer.

MARSEILLES LOCK.

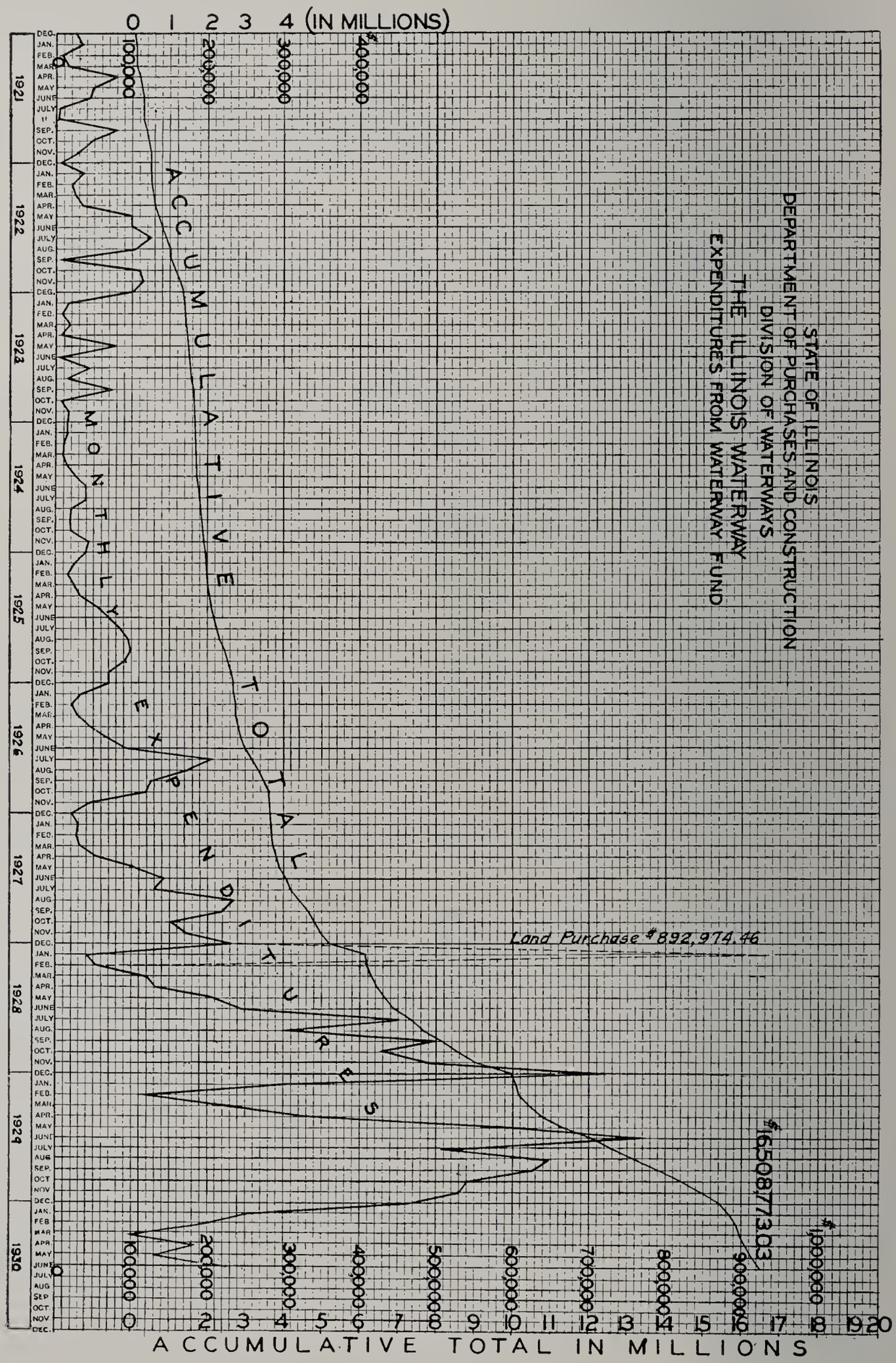
The lock masonry was completed in 1923, the gates, valves and lower approach wall in 1929. During this fiscal year the addition of air chambers to the miter gates and changes in bearing materials of pintles was completed. The operating machinery could have been installed but in the interest of economy to both State and Contractor, was deferred. Practically all the machinery except motors has been delivered at the lock site.

MARSEILLES CANAL.

Rapid progress on this work was continued until its completion, acceptance and final payment, which was made in April, 1930. After the Marseilles dam is completed, the completed portion of the canal can be connected to the river above the dam by the excavation of about 71,000 cubic yards of rock and earth.

STARVED ROCK LOCK AND DAM.

The contract for the masonry, etc., was completed and the work accepted in May, 1930. Final payment, however, has not been made on account of pending claims for extra costs.


STATE OF ILLINOIS
DEPARTMENT OF PURCHASES AND CONSTRUCTION
DIVISION OF WATERWAYS
THE ILLINOIS WATERWAY
EXPENDITURES FROM WATERWAY FUND
ACCUMULATIVE TOTAL EXPENDITURES
MONTHLY EXPENDITURES
Land Purchase $892,974.46
$16508773.03
0 1 2 3 4 (IN MILLIONS)
0 100,000 200,000 300,000 400,000
1921
1922
1923
1924
1925
1926
1927
1928
1929
1930
0 100,000 200,000 300,000 400,000 500,000 600,000 700,000 800,000 900,000 1,000,000
0 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
ACCUMULATIVE TOTAL IN MILLIONS

The work under Contract No. 7 for the miter gates, valves and Taintor gates was completed the last of June, and its acceptance and final payment are to be made in July. These structures are the finest examples of steel construction the writer has ever seen and the Independent Bridge Company of Pittsburgh, Pennsylvania, are deserving of the highest commendation for their excellent work.

The installation of lock machinery is about 75 per cent completed.

Details relative to this lock and dam are given in the report of J. B. Bassett, Division Engineer.

CHANNEL DREDGING.

The contract for and description of this work, and the State dredging fleet, are discussed on pages 39 and 67 of the Twelfth Annual Report. During this fiscal year dredging was done only in the Marseilles pool, from which was dredged 215,642 cubic yards of sand, gravel and boulders. The material is excavated by the oil burner dipper dredge "Louis L. Emmerson," loaded upon 300 ton capacity disposal barges, towed to spoil area locations by the stern wheel, Diesel towboat "Patricia Lou Watson" where it is unloaded on to the shore by a tractor crane mounted upon a floating crane barge.

All of this dredging equipment is owned by the State but is operated and maintained by and at the expense of the dredging contractor.

PROGRESS SHOWN BY EXPENDITURES.

Presented herewith is a tabulation which shows for each month of the fiscal year the expenditures from the Waterway Fund for each contract and for other principal items of cost. The payments on contracts or projects are a fair indication of the construction progress. There is also shown in graphic form the total expenditures from the Waterway Fund from 1919 to date, which clearly indicates the progress on The Illinois Waterway as a whole during the past 11 years.

HIGHWAY BRIDGES.

BRIDGES AT JOLIET.

Progress during the fiscal year relative to Federal permits for the five movable bridges over the DesPlaines River in the city of Joliet is covered in the foregoing under the subject of Brandon Road—Joliet Pool.

The type and clearances of the bridges to be constructed in the city of Joliet has been for years the subject of controversy between United States and State officials, and the officials and citizens of Joliet. The record on this subject to June 30, 1929, was briefly covered on pages 41 to 43 of the Twelfth Annual Report.

These bridges must be movable. One, and possibly all five, of the bascule type, which is a highly specialized class of bridge. The Division decided some years ago that it was not in the best interest of the State to develop its own designing force for the movable spans of these bridges. Owing to the changes in these bridges required by the Federal government, their design has been delayed and when the permits are received

the time required for the preparation of plans and specifications will become the most important factor in the completion of the waterway.

To meet this situation the employment of specialists is considered imperative and under date of May 26, 1930, invitations were extended to a few bridge engineering firms to enter a competition and submit general plans and estimates of cost of the types of bridges in which they specialize. Under the original program the data was to be submitted July 21, 1930, but subsequently the time of submitting data was extended to August 25, 1930.

The War Department is withholding final action on the State's application for permits until it is advised of the result of this competition.

BRIDGES BELOW JOLIET.

Application for Federal permit for construction of a bascule bridge at Brandon Road over the lower approach of the lock was filed February 18, 1929. The Federal permit for same was issued March 31, 1930. On February 18, 1929, an application for Federal permit was filed for a 200 foot vertical lift span over the Marseilles canal, and on January 16, 1929, applications were filed for similar bridges over the DesPlaines River at Treats Island and Smith's Highway. These bridges as proposed provided 200 foot clear spans, 16½ feet vertical clearance in closed position and 50 feet when raised.

On May 31, 1929 the Smith's and Treats Island bridge applications were returned by the War Department, disapproved, with the statement of the Chief of Engineers

"that consideration will be given to plans for a bridge of same type with horizontal clearance of 250 feet and vertical clearance, when open, of 60 feet above place of highest flood at locus of bridge."

REVISED APPLICATIONS PENDING.

Between September, 1929, and January, 1930, applications were filed with revised plans showing vertical lift type of 225 feet horizontal span, not less than 16½ feet vertical clearance in closed and 50 feet above high water in raised position, for the five highway bridges over the DesPlaines and Illinois rivers. Thus before February 1, 1930, applications for Federal permits were on file for all bridges below Joliet. These bridges in their downstream order are located at Brandon Road, Treats Island, Smith's Highway, Morris, Seneca, Marseilles Canal and Ottawa. The officially reported estimated cost of these seven bridges based on the permit application plans was $1,216,800.

These proposed plans (except those for the Brandon Road Bridge) were unsatisfactory to the reorganized U. S. Engineer Department, but the bridge problem was given special consideration by the Department, and after much correspondence and many conferences, the War Department definitely determined what dimensions of bridges would meet with their approval. For bridges over the Illinois River these dimensions were 350 feet horizontal span clearance, 30 feet vertical clearance for movable bridges in closed position and 47 feet above normal pool elevation for fixed bridges or movable bridges when raised.

EXPENDITURES FROM ILLINOIS WATERWAY CONSTRUCTION FUND AS VOUCHERED BY DIVISION OF WATERWAYS FROM JULY 1, 1929, TO JUNE 30, 1930.

Item.	Description.	July.	August.	September.	October.	November.	December.	January.	February.
Contract No. 2	Starved Rock		$ 17,512 19	$ 25,741 92	$ 3,200 00	$ 39,407 89	$ 58,588 22	$ 3,494 11	$ 69,433 94
Project No. 3	Dresden Island	$ 76,525 72	24,318 82	170,274 80	63,903 66	58,350 53	55,082 36	49,964 04	14,873 80
Projects Nos. 5 and 6	Joliet Works	227,645 82	259,732 24	225,991 46	175,813 38	214,662 61	83,022 72	44,828 00	22,339 20
Contract No. 7	Gates—Starved Rock	5,157 98	27,943 38	28,236 78	7,907 70	32,731 73	45,526 13	14,713 74	5,286 26
Contract No. 8	Machinery							17,856 04	
Contract No. 9-A	Pool dredging	22,014 00		9,000 00	70,203 58	20,000 00	21,200 00	10,000 00	5,100 00
Contract No. 9-B	Marseilles Canal	26,190 00	63,953 82	68,000 00	65,000 00	67,308 00	105,040 00	29,876 39	28,300 50
Contract No. 10	Gates, etc	44,621 96	65,247 94	105,489 51	16,723 30	18,875 71	64,590 67	56,195 55	28,804 45
Total structures		$402,155 48	$458,708 39	$632,734 47	$402,751 62	$451,336 47	$433,050 10	$226,927 87	$174,137 65
Cement		53,281 70	56,881 74	50,787 80	95,246 18	60,416 46	12,040 54	1,109 70	2,805 08
Permanent plant		24,568 96	26,986 08	3,051 65	23,150 53	471 07		1,234 51	132 98
Land, etc		6,442 75	212 00					978 00	
Eng. payrolls		16,677 91	17,544 84	18,419 70	16,679 91	16,514 90	16,131 93	14,607 74	12,315 00
Office expense		699 56	252 40	402 14	497 58	477 07	235 30	402 64	446 15
Miscellaneous expense		3,111 70	2,155 36	1,488 04	954 41	516 30	3,523 60	1,703 42	594 26
Equipment and supplies		376 81	213 71	687 66	323 83				
Travel expense		373 58	1,202 98	1,171 42	833 47	655 60	574 00	703 68	777 39
Total for month		$507,688 45	$564,157 50	$708,742 89	$540,437 53	$530,387 87	$465,555 47	$247,667 56	$191,208 51

EXPENDITURES FROM ILLINOIS WATERWAY CONSTRUCTION FUND AS VOUCHERED BY DIVISION OF WATERWAYS FROM JULY 1, 1929, TO JUNE 30, 1930—Concluded.

Item.	Description.	March.	April.	May.	June.	Total.	Remarks.
Contract No. 2	Starved Rock					$ 217,378 27	
Project No. 3	Dresden Island	$ 3,759 07	$ 2,416 02	$ 2,020 64	$ 3,095 82	524,585 28	
Projects Nos. 5 and 6	Joliet Works	24,622 58	17,537 42	13,167 93	10,480 57	1,319,843 93	
Contract No. 7	Gates—Starved Rock		*55,111 09	56,418 94	23,619 47	302,653 20	* Paid in May. April voucher cancelled.
Contract No. 8	Machinery	21,985 16			50,142 84	89,984 04	
Contract No. 9-A	Pool dredging	14,900 00	10,000 00		15,580 00	197,997 58	
Contract No. 9-B	Marseilles Canal	17,100 00	*141,592 39			612,361 10	* Completed contract.
Contract No. 10	Gates, etc				112,923 18	513,471 57	
Total structures		$82,366 81	$226,656 92	$71,607 51	$215,841 88	$3,778,274 97	
Cement		379 50			1,140 05	334,088 75	
Permanent plant		51 43			1,288 80	80,936 01	
Land, etc						7,632 75	
Eng. payrolls		12,382 74	10,940 00	8,780 32	8,640 00	169,635 00	
Office expense		368 86	275 73	166 87	193 34	4,418 34	
Miscellaneous expense		812 18	14 05	24 37	26 22	14,923 91	
Equipment and supplies						1,602 01	
Travel expense		405 24	405 39	489 11	459 45	8,051 39	
Total for month		$96,766 76	$238,301 09	$81,068 18	$227,589 74	$4,399,563 13	

FIXED BRIDGES FAVORED.

Prior to this decision the required elevation of fixed bridges had been 65 feet above high water. Such a height made the cost of fixed bridges greatly in excess of the cost of movable bridges.

Studies and estimates were rapidly completed, which showed that fixed bridges of the new required clearances could be constructed for substantially the same cost as the vertical lift bridges of 225 foot span. This would be a distinct advantage to the State as future operating and maintenance costs of movable bridges would be saved. This saving will amount to about $8,000 per annum per bridge, or about $50,000 per year, or the interest at 4 per cent on $1,250,000.

Revised permit plans for these bridges were prepared and the aplications re-submitted for six fixed bridges.

A Federal permit has been received for the fixed bridge at Ottawa, but the other applications were still before the War Department at the end of the fiscal year.

Flood Relief.

Flood relief work was carried on during the year under the provisions of various flood relief acts passed by the Fifty-sixth General Assembly. These acts appropriated the sum of $1,849,229.47 to the Department of Purchases and Construction for the biennium commencing July 1, 1929. Of the above sum, $219,229.47 was a reappropriation of funds left over at the end of the preceding biennium from the emergency flood relief act of 1927.

The work contemplated under each of these acts was the furnishing of relief to areas devastated by floods by the control and prevention of floods through the building of levees, channels, revetments and other flood control works.

The procedure in carrying out the purposes of these acts remained largely the same as used in 1927 with the flood relief act of that year. A questionnaire was prepared and mailed to all flood relief applicants asking for necessary information concerning each project. Further information was obtained by a visit of the Division Engineer in charge of flood relief to each applicant and a careful inspection by him of engineering and other features of each project. A report embodying the results of each investigation was prepared and forwarded to the Director of this Department.

Flood relief continued to be in charge of Mr. L. C. Craig, Division Engineer, with headquarters at the Chicago office. The office at East Peoria, Illinois, was discontinued May 31, 1930 and a new office opened at Beardstown, Illinois.

Progress of flood relief work.

The flood relief acts passed by the Fifty-sixth General Assembly were not emergency measures in the sense that it was necessary to make immediate and extensive emergency repairs to levees as was necessary in 1927 to enable farmers to plant crops. It was possible, therefore, to take the necessary time for a more careful investigation of each application. In the case of applicants for relief along the Illinois River below

Beardstown where cooperation with the Federal Government was necessary, it was not possible for the State to make an allotment of funds or enter into a contract until the Federal Government had first completed its investigation and was ready to ask the Drainage District or other local agency for its contribution of one-third of the total cost.

Good progress was made during the year in the investigation of applications for relief, several contracts were let and necessary preparatory work was done, which will enable the State to construct many projects during the summer of 1930. Progress on the Farm Creek diversion channel and new highway bridge is covered in the report of W. M. Smith, Assistant Chief Engineer.

STATEMENT OF EXPENDITURES.

Appropriations for flood relief, Fifty-sixth General Assembly.	$1,849,229.47
Expended and obligated by existing contracts during the fiscal year 1929-1930	302,245.15
Available balance July 1, 1930	$1,546,984.32

Further information on flood relief is contained in report of L. C. Craig, Division Engineer.

MISCELLANEOUS CONSTRUCTION.

Under special appropriations of the legislature a culvert was constructed at Clark's Run, Utica, a bridge is under construction over the Illinois and Michigan Canal at Chestnut Street, Ottawa, and the concrete channel, bridge, substructure and superstructure are under contract and construction for the Farm Creek diversion channel at East Peoria, which is a flood relief project. These projects are more fully covered in the report of Walter M. Smith, Assistant Chief Engineer.

REPORT OF DESIGNING SECTION.

By Walter M. Smith, *Assistant Chief and Chief Designing Engineer.*

ORGANIZATION.

The Designing Department at the beginning of the year consisted of:

1 Assistant Chief and Chief Designing Engineer.
2 Designing Engineers.
1 Mechanical Engineer.
1 Electrical Engineer.
1 Engineer on half time basis.
4 Assistant Engineers.
7 Draftsmen.
1 Draftsman, part time basis.

The following employes were added during the year:

1 Assistant Engineer was appointed August 6, 1929.
1 Timekeeper transferred to office January 26, 1930.

The following employes were dropped from the service during the year:

1 Assistant Engineer was dropped June 1, 1930.
1 Assistant Engineer was dropped June 15, 1930.
2 Draftsmen were dropped June 15, 1930.
1 Draftsman was furloughed without pay February 1, 1930.
1 Timekeeper resigned to accept another position May 1, 1930.

The Designing Department at the end of the year consisted of:

1 Assistant Chief and Chief Designing Engineer.
2 Designing Engineers.
1 Mechanical Engineer.
1 Electrical Engineer.
1 Engineer on half time basis.
3 Assistant Engineers.
4 Draftsmen.

The following work was done in the Designing Department during the year in drafting work:

Drawings made, pencil, 264.
Finished tracings, standard size, 93.
Finished tracings, small size, 35.
Sketches and studies, 56.
Shop prints checked, 52.
Shop bills checked, 330.

THE ILLINOIS WATERWAY—DRESDEN ISLAND LOCK AND DAM CONTRACT NO. 3.

The superintendents of this work found and purchased a very satisfactory gravel bed less than two miles from the site of the dam, constructed a railroad from the dam to the gravel pit and used the gravel in the concrete for the lock and dam. The gravel was used as it came from the pit without washing or addition of any other material. There is just a sufficient amount of silt in the gravel to lubricate the concrete mixture thoroughly and make a very strong concrete. There is a slight lack of fine material in the gravel, however, causing the concrete to be somewhat porous. This, however, does not affect the strength as was proved by tests of samples made at the testing laboratory, Lewis Institute.

LABORATORY TESTS OF CONCRETE.

Some of these tests are as follows:

December 3, 1929.

No.	Age in Days.	Bbls. of Cement per cu. yard.	Unit Stress in lbs. per sq. in.
1	50	1.0	2,100
2	50	1.0	2,370
3	50	1.0	2,050
Average			2,173
4	50	1.25	2,180
5	50	1.25	1,780
6	50	1.25	2,230
7	50	1.25	1,920
Average			2,028
8	50	1.5	2,330
9	50	1.5	2,690
10	50	1.5	3,000
11	50	1.5	2,240
Average			2,566
December 28, 1929.			
1	7	1.35	2,090
2	7	1.35	2,720
Average			2,405

Some trouble was experienced during the winter season from frozen concrete due to neglect of proper precautions when concreting in extremely cold weather. Some of the concrete had to be cut out due to this.

Work was suspended on this contract about February 1, 1930, due to lack of available funds. Since that time only a small force has been kept at the site to look after the maintenance of the cofferdam and keep it pumped out. The contractors were notified of the cancellation of the contract on June 5, 1930.

BRANDON ROAD POOL PROJECT NO. 6—BRANDON ROAD LOCK AND DAM PROJECT NO. 5.

Work was continued on this project with very satisfactory progress until about the first of February, 1930, when work was almost completely stopped for lack of funds.

The superintendents were allowed to continue work on the sewer crossing McDonough Street on the east side of the river, and on the 36-inch cast iron pipe sewer crossing the river connecting the sewers in the east and west walls, until same were completed.

Early in the year it was noticed that one of the piers about midway of the upstream approach wall at the lock was splitting down the center due to the shrinkage in the deck slabs being concentrated at this pier instead of the shrinkage of each deck slab being taken up by slipping on the pier at one end of that as has occurred at the completed locks heretofore and as was planned. The same thing occurred in the forebay ice protection wall at a pier about one-third the distance out from the head gate structure. Shores were placed under the ends of the abutting deck slabs at these two piers until the upper portions of the piers can be rebuilt.

The superintendents were notified on June 5, 1930 of the cancellation of their contract of employment, effective July 5.

BRANDON ROAD AND DRESDEN ISLAND METAL WORK—CONTRACT NO. 10.

There were fifty shop prints checked, alterations made, where necessary, and correct prints signed and returned to the contractor.

The guard gates and upper lock gates at Brandon Road lock were erected and most of the metal that was to be placed in the concrete at this site was placed but at Dresden Island site only the pintle bed plates and reaction bearings and metal reinforcement around the anchorages for these two gates were placed.

All of the steel work and other materials for this contract have been received and stored temporarily at the sites.

There have been 144 shop bills checked for Dresden Island in the Designing Department. The shop bills for Brandon Road material were checked in that office.

MARSEILLES DAM.

The design of this dam submitted to the U. S. Engineers was approved and several pencil drawings were made to be turned over to the U. S. Engineer Officer, who is to be in charge of the work after transfer, for tracing.

MARSEILLES CANAL, CONTRACT NO. 9B.

Work was continued on this contract vigorously and rapidly. The contractors were allowed to dispose of the spoil in a different manner from that shown on the contract drawings.

Owing to lack of information concerning elevation of the rock surface, the Contractors had to excavate almost double the amount of rock and only about one-half the quantity of earth estimated.

The work on this contract was completed the latter part of April, final inspection made, and the work accepted.

RIVER EXCAVATION CONTRACT, NO. 9A, C & D

Work was continued on this contract in the Marseilles Pool.

STARVED ROCK LOCK AND DAM, CONTRACT NO. 2.

The Contractors on this contract were directed to take out the last section of the dam cofferdam on the upstream side down to the elevation of the concrete apron on the upstream side of the dam. After their contract was reported completed and they had removed their plant it was found that this had not been done, the cofferdam being left at an elevation several feet above that directed and extending the length of three Taintor gate openings. It is impossible now to force the Contractors to come back and remove this material and it would be very expensive. As soon as the canal is in operation a dredge can remove the surplus material at small expense.

STARVED ROCK METAL WORK, CONTRACT NO. 7.

The work on this contract was completed and the Taintor gates all operated and the air and steam pipe lines tested. The Contractors did thoroughly satisfactory work throughout and the structures make a very fine appearance.

Checking of weights on shop bills was all done in the designing office as there was no adequate force to check them at the site. There were 186 of these shop bills checked.

GATE AND VALVE OPERATING MACHINERY, CONTRACT NO. 8.

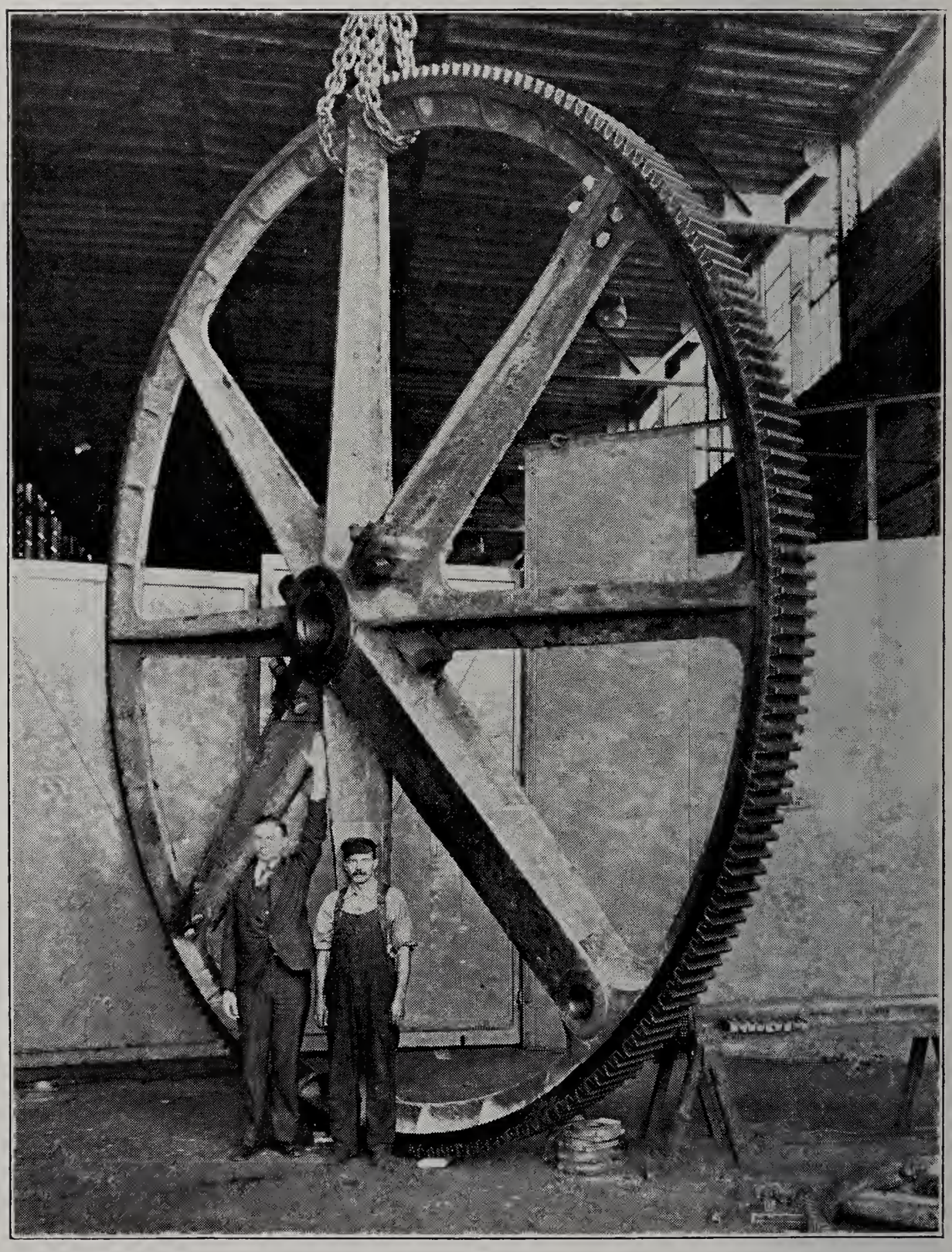
The installation of gate and valve operating machinery at Lockport Lock was completed and tested on September 13, 1929.

The miter gate operating machinery operated in a thoroughly satisfactory manner. Each gate was swung fifty times each way, the average time for either opening or closing being one minute. This was better than called for in the specifications and the contractors were directed to proceed with the gate operating machinery for the other locks.

When the valve operating machinery was tested, one refused to work. Another worked for a short time and then jammed. Upon examination it was found that the jarring at the starting of the motor was so great that the concrete pedestals carrying the bearings for the horizontal drive shaft were badly cracked allowing the shaft to wabble. It was seen that either a differential controller, similar to that used on electric cars, would have to be used or the shaft bearings, gears and pinions would

have to be mounted on a cast iron or steel frame to hold them accurately in position. There were several objections to the controller method so a cast steel windlass frame was designed to carry the bearings. This was built and tested at Lockport and worked with thorough satisfaction. Orders were then given to proceed with the valve machinery for the other locks as revised.

Three of the gate operating machines have been installed at Starved Rock Lock, except motors and lubricating devices, and one partly in-



Lock Gate Machinery. Bull-wheels aid in moving the heavy mitering type lock gates of The Illinois Waterway. This wheel is 19 feet in diameter and weighs 13 tons.

stalled at Marseilles Lock. The valve operating machinery has been delivered at Starved Rock Lock but not installed.

LOCKPORT LOCK EMERGENCY GATE.

The counterweights were placed on the emergency gate at Lockport Lock without the use of a diver as it at first appeared would be necessary, as the Sanitary District drew the water down for several days so that the upstream cofferdam was of sufficient height to keep the water out.

After the weights were all put on, the water was let in and the gate operated several times. It operated with thorough satisfaction. The time required to raise or lower was seven minutes.

ELECTRIC LIGHTING, POWER AND SIGNALLING SYSTEMS, CONTRACT NO. 12.

Work was continued on this contract, the following drawings having been made:

3 Penciled studies.
23 Original drawings.
24 Finished tracings.

This contract cannot be advertised for some time as it will include the finishing up of all electrical work at all the dams and one lock and two dams have not yet been constructed.

BRIDGES.

Sketches were made and applications made to the U. S. Engineer Department for permits to construct the bridges over the Illinois Waterway. Objections were made to both vertical and horizontal clearance in most cases and revised applications were called for, giving such greater vertical and horizontal clearance than those first submitted.

The applications for Jefferson Street, Brandon Road, Joliet, and LaSalle Street, Ottawa, bridges have been approved by the U. S. Engineer Department.

ILLINOIS AND MICHIGAN CANAL—CHESTNUT STREET BRIDGE, OTTAWA.

Design and drawings were completed, proposals called for on May 12 and opened on June 3, 1930. A copy of the canvass of bids is attached.

The contract was awarded to the lowest bidder, The Independent Bridge Company, Neville Island, Pittsburgh, Pa.

Erection has not yet been started.

CLARK'S RUN CULVERT, UTICA.

A culvert was designed to carry Clark's Run at Utica under the Illinois and Michigan Canal, where there is a small wooden culvert at present. Drawings and specifications were prepared, proposals invited and opened on February 28, 1930. A copy of the canvass of bids is attached.

The contract was awarded to the lowest bidder, the Peerless Construction Company of Chicago.

It was found after starting construction that the culvert instead of being all in earth, as assumed for design, would be almost entirely

ILLINOIS AND MICHIGAN CANAL—CHESTNUT STREET BRIDGE, OTTAWA, ILLINOIS—CANVASS OF BIDS RECEIVED JUNE 3, 1930.

Item No.	Item.	Unit.	Quantities.	Independent Bridge Co., Neville Island Branch, Pittsburg, Pa.		Milwaukee Bridge Co., 1410 34th St., Milwaukee, Wis.		Joliet Bridge & Construction Co., 510 Morris Bldg., Joliet, Ill.		Peerless Construction Co., 28 E. Jackson Blvd., Chicago, Ill.		Messer Bros. Construction Co., 9942 S. Leavitt St., Chicago, Ill.	
				Price.	Amount.	Price.	Amount.	Price.	Amount.	Price.	Amount.	Price.	Amount.
A	For removing and disposing of old span and constructing new superstructure	Lump sum	1	--------	$17,240 00	--------	$17,714 00	--------	$16,400 00	--------	$18,568 00	--------	$19,517 00
B	For masonry removed from pier abutments	Cubic yard	50	$ 3 00	150 00	$ 3 00	150 00	$ 3 00	150 00	$ 5 00	250 00	$ 3 00	150 00
C	Concrete pavement removed	Square yard	55	30	16 50	2 00	110 00	2 00	110 00	4 00	220 00	1 25	68 75
D	Rock excavation	Cubic yard	50	4 00	200 00	5 00	250 00	5 00	250 00	5 00	250 00	4 00	200 00
E	Earth excavation	Cubic yard	400	1 25	500 00	2 00	800 00	2 50	1,000 00	4 00	1,600 00	1 50	600 00
F	Concrete for pier and abutments	Cubic yard	250	17 00	4,250 00	19 00	4,750 00	25 00	6,250 00	14 50	3,625 00	18 85	4,713 00
G	Reinforcing steel	Pound	1,800	07	126 00	05	90 00	05	90 00	07	126 00	06	108 00
H	Fill in the approaches	Cubic yard	300	1 50	450 00	1 00	300 00	1 00	300 00	2 00	600 00	1 00	300 00
I	Concrete pavement	Square yard	130	3 00	390 00	3 00	390 00	2 50	325 00	4 25	552 50	2 85	370 50
J	Cement sidewalk	Square foot	470	25	117 50	25	117 50	25	117 50	50	235 00	40	188 00
	Total			--------	$23,440 00	--------	$24,671 50	--------	$24,992 50	--------	$26,026 50	--------	$26,214 50

ILLINOIS AND MICHIGAN CANAL—CULVERTS FOR CLARK'S CREEK, UTICA, AND NEAR SENECA (HOLDERMANS)—CANVASS OF BIDS OPENED FEBRUARY 28, 1930.

Item No.	Item.	Unit.	Quantities.	Peerless Construction Co., Chicago, Ill.		Messer Bros. Construction Co., Chicago, Ill.		L. A. Wilson & Co., Ottawa, Ill.		C. E. Carson Co., Chicago, Ill.		Congress Construction Co., Chicago, Ill.	
				Price.	Amount.	Price.	Amount.	Price.	Amount.	Price.	Amount.	Price.	Amount.
	Clark's Creek, Utica—												
A	Cofferdams and pumping	Lump sum	1		$1,196 00		$1,861 00		$3,000 00		$4,450 00		No bid
B	Excavation	Cubic yard	2,400	$ 1 80	4,320 00	2 00	4,800 00	1 25	3,000 00	1 90	4,560 00		
C	Douglas fir timber (net)	B. M. ft	31,000	93 00	2,883 00	94 00	2,914 00	105 00	*3,255 00	185 00	5,735 00		
D	Concrete	Cubic yard	140	15 00	2,100 00	22 00	3,080 00	25 00	3,500 00	23 00	3,220 00		
	Total				$10,499 00		$12,655 00		$12,755 00		$17,965 00		
	Culvert near Seneca (Holdermans)—												
A	Cofferdams and pumping	Lump sum	1		$1,733 50		$2,150 00		$5,000 00		$6,160 00		$2,000 00
B	Excavation	Cubic yard	1,300	$ 2 00	2,600 00	$ 2 00	2,600 00	$ 2 00	2,600 00	$ 1 90	2,470 00		For supervising work and furnishing equipment only. See letter 2-27-30.
C	Douglas fir timber (net)	B. M. ft	16,500	95 00	1,567 50	94 00	1,551 00	132 00	*2,178 00	185 00	3,052 50		
D	Concrete	Cubic yard	140	15 00	2,100 00	23 00	3,220 00	29 00	4,060 00	23 00	3,220 00		
	Total				$8,001 00		$9,521 00		$13,838 00		$14,902 50		
	Total bid-both culverts				$18,500 00		$22,176 00		$26,593 00		$32,867 50		

	Utica.	Seneca.
* Add—		
For No. 1 common fir, No. 12 treatment	$1,600 00	$800 00
For No. 1 rough Y. P., No. 10 treatment	1,200 00	600 00

FARM CREEK DIVERSION CHANNEL (EAST PEORIA)—CANVASS OF BIDS RECEIVED MARCH 24, 1930.

Item No.	Item.	Unit.	Quantities.	Porter & McCully, Mackinaw, Ill.		Congress Construction Co., Chicago, Ill.		Walsh Construction Co., Davenport, Iowa.	
				Price.	Amount.	Price.	Amount.	Price.	Amount.
1-A	Class A excavation	Cubic yard	16,000	$ 40	$ 6,400 00	$ 60	$ 9,600 00	$ 85	$13,600 00
1-F	Concrete excavation	Square yard	450	2 00	900 00	1 50	675 00	1 00	450 00
8	Concrete pavement	Square yard	1,500	2 25	3,375 00	2 75	4,125 00	3 30	4,950 00
17	Rip rap	Cubic yard	3,300	1 25	4,125 00	6 50	21,450 00	5 40	17,820 00
26-A	Class A concrete	Cubic yard	740	23 00	17,020 00	18 90	13,986 00	19 50	14,430 00
27	Reinforcing steel	Pound	54,000	035	1,890 00	06	3,240 00	04	2,160 00
30-A	Untreated piles	Lineal foot	1,000	70	700 00	60	600 00	80	800 00
39	Steel sheet piling	Square foot	4,000	1 00	4,000 00	80	3,200 00	90	3,600 00
40	Earth fill	Cubic yard	8,500	40	3,400 00	35	2,975 00	18	1,530 00
41	Yellow pine or Douglas fir timber	M. F. B. M	20	80 00	1,600 00	100 00	2,000 00	95 00	1,900 00
42	Removing temporary highway detour	Lump sum	1	600 00	600 00	1 00	1 00	400 00	400 00
	Total				$44,010 00		$61,852 00		$61,640 00
	Work to be done under T. P. & W. Railroad specifications and paid for by East Peoria Sanitary District—								
1	Earth excavation	Cubic yard	7,300	$ 40	$ 2,920 00	$ 1 00	$ 7,300 00	$ 90	$ 6,570 00
2	Concrete pavement	Square yard	1,100	2 25	2,475 00	2 75	3,025 00	3 00	3,300 00
3	Concrete	Cubic yard	1,850	22 90	42,365 00	14 80	27,380 00	16 40	30,340 00
4	Reinforcing steel	Pound	22,000	035	770 00	06	1,320 00	04	880 00
5	Timber piles	Lineal foot	14,000	70	9,800 00	60	8,400 00	50	7,000 00
	Total				$58,330 00		$47,425 00		$48,090 00
	Grand total				[1]$102,340 00		[2]$109,277 00		[3]$109,730 00

[1] Alternate bid $125.00 added to total bid as written in the bid.
[2] Alternate bid $109,573.00 and alternate bid on pavement $5.41 a square yard, $113,563.00 = $19.50 cu. yd. 10-16 × $19.50 = $5.41. This bid is not clear.
[3] Alternate bid $.05 per cubic yard as written in the bid.

FARM CREEK DIVERSION CHANNEL (EAST PEORIA)—CANVASS OF BIDS RECEIVED MARCH 24, 1930—Concluded.

Item No.	Item.	Unit.	Quantities.	Hartman, Clarke Bros. Co., Peoria, Ill.		Sword & McDougal Co., Peoria, Ill.		Schmidt Construction Co., Peoria, Ill.	
				Price.	Amount.	Price.	Amount.	Price.	Amount.
1-A	Class A excavation	Cubic yard	16,000	$ 45	$ 7,200 00	$ 50	$ 8,000 00	$ 30	$ 4,800 00
1-F	Concrete excavation	Square yard	450	1 50	675 00	1 00	450 00	70	315 00
8	Concrete pavement	Square yard	1,500	3 35	5,025 00	3 36	5,040 00	3 00	4,500 00
17	Rip rap	Cubic yard	3,300	6 50	21,450 00	6 00	19,800 00	6 00	19,800 00
26-A	Class A concrete	Cubic yard	740	21 85	16,169 00	23 26	17,212 40	24 00	17,760 00
27	Reinforcing steel	Pound	54,000	045	2,430 00	04	2,160 00	04	2,160 00
30-A	Untreated piles	Lineal foot	1,000	50	500 00	73	730 00	60	600 00
39	Steel sheet piling	Square foot	4,000	85	3,400 00	1 58	6,320 00	2 00	8,000 00
40	Earth fill	Cubic yard	8,500	40	3,400 00	40	3,400 00	30	2,550 00
41	Yellow pine or Douglas fir timber	M. F. B. M	20	105 00	2,100 00	75 00	1,500 00	30 00	600 00
42	Removing temporary highway detour	Lump sum	1	500 00	500 00	500 00	500 00	100 00	100 00
	Total				$62,849 00		$65,112 40		$61,185 00
	Work to be done under T. P. & W. Railroad specifications and paid for by East Peoria Sanitary District—								
1	Earth excavation	Cubic yard	7,300	$ 65	$ 4,745 00	$ 50	$ 3,650 00	$ 50	$ 3,650 00
2	Concrete pavement	Square yard	1,100	3 10	3,410 00	2 83	3,113 00	3 00	3,300 00
3	Concrete	Cubic yard	1,850	20 40	37,740 00	20 32	37,592 00	24 00	44,400 00
4	Reinforcing steel	Pound	22,000	045	990 00	04	880 00	04	880 00
5	Timber piles	Lineal foot	14,000	50	7,000 00	63	8,820 00	60	8,400 00
	Total				$53,885 00		$54,055 00		$60,630 00
	Grand total				[4]$116,734 00		[5]$119,167 40		$121,815 00

[4] Alternate bid $117,070.00 as bid.
[5] Alternate bid 24 cents per cubic yard as written in the bid.

FARM CREEK DIVERSION CHANNEL BRIDGE (EAST PEORIA)—CANVASS OF BIDS RECEIVED FEBRUARY 5, 1930.

Item No.	Item.	Unit.	Quantities.	Milwaukee Bridge Co., 1410 34th St., Milwaukee, Wis.		Continental Bridge Co., Peotone, Ill.		Illinois Steel Bridge Co., Jacksonville, Ill.	
				Price.	Amount.	Price.	Amount.	Price.	Amount.
26X	Concrete	Cubic yard	130	$20 00	$ 2,600 00	$22 00	$ 2,860 00	$21 00	$ 2,730 00
27	Reinforcing steel	Pound	15,000	05	750 00	04	600 00	04½	675 00
32	Structural steel	Pound	275,000	05½	15,125 00	06	16,500 00	064	17,600 00
37	Cast iron	Pound	3,700	10½	388 50	10	370 00	10	370 00
	Total				$18,863 50		$20,330 00		$21,375 00

FARM CREEK DIVERSION CHANNEL BRIDGE (EAST PEORIA)—CANVASS OF BIDS RECEIVED FEBRUARY 5, 1930—Concluded.

Item No.	Item.	Unit.	Quantities.	Lakeside Bridge & Steel Co., Milwaukee, Wis.		Independent Bridge Co., Neville Island Branch, Pittsburg, Pa.		Duffin Iron Co., 4837 S. Kedzie Ave., Chicago, Ill.	
				Price.	Amount.	Price.	Amount.	Price.	Amount.
26X	Concrete	Cubic yard	130	$27 20	$ 3,536 00	$26 00	$ 3,380 00	$35 00	$ 4,550 00
27	Reinforcing steel	Pound	15,000	04½	675 00	05	750 00	06¼	937 50
32	Structural steel	Pound	275,000	063	17,325 00	07	19,250 00	0673	18,507 50
37	Cast iron	Pound	3,700	10	370 00	10	370 00	11½	425 50
	Total				$21,906 00		$23,750 00		$24,420 50

FARM CREEK DIVERSION CHANNEL (EAST PEORIA)—CANVASS OF BIDS RECEIVED MAY 12, 1930.

Item No.	Item.	Unit.	Quantities.	Swords-McDougal Co., Peoria, Ill.		Hartman, Clarke Bros. Co., Peoria, Ill.		Porter & McCully, Lexington, Ill.	
				Price.	Amount.	Price.	Amount.	Price.	Amount.
1-A	Class A excavation	Cubic yard	16,000	$ 45	$ 7,200 00	$ 40	$ 6,400 00	$ 45	$ 7,200 00
1-F	Concrete pavement excavation	Square yard	450	1 25	562 50	1 25	562 50	1 50	675 00
8-A	Concrete pavement in channel—12 inches thick	Square yard	550	3 25	1,787 50	4 50	2,475 00	3 50	1,925 00
8-B	Concrete pavement in channel—8 inches thick	Square yard	950	2 80	2,660 00	3 50	3,325 00	2,70	2,565 00
8-C	Concrete pavement in roadway	Square yard	2,600	2 60	6,760 00	2 65	6,890 00	2 25	5,850 00
9	Rip rap	Cubic yard	3,300	6 00	19,800 00	5 00	16,500 00	4 65	15,345 00
26-A	Concrete, class A	Cubic yard	740	22 00	16,280 00	22 50	16,650 00	23 00	17,020 00
27	Reinforcing steel	Pound	48,000	04	1,920 00	045	2,160 00	03½	1,680 00
30-A	Timber piles untreated	Lineal foot	3,400	60	2,040 00	60	2,040 00	70	2,380 00
39	Steel sheet piling	Square foot	4,000	90	3,600 00	1 00	4,000 00	1 00	4,000 00
40-A	Earth fill in detour	Cubic yard	2,000	40	800 00	40	800 00	45	900 00
40-B	Earth fill in roadway	Cubic yard	8,500	40	3,400 00	40	3,400 00	50	4,250 00
41	Gravel fill in detour	Cubic yard	600	1 50	900 00	2 00	1,200 00	1 80	1,080 00
42	Excavation in detour	Cubic yard	2,600	50	1,300 00	40	1,040 00	45	1,170 00
					$69,010 00		$67,442 50		$66,040 00

in rock cut. A revision was, therefore, made in the design and modifications in the contract, and the contract was finished in less than the time allowed at a cost slightly less than the amount bid in the first contract.

HOLDERMAN'S CULVERT, SENECA.

A culvert was designed to replace the small wooden culvert under the Illinois and Michigan Canal. This culvert was advertised and bids opened at the same time as the Clark's Run Culvert, Utica. After the bids were opened there was a strong protest against building a larger culvert at this place made by the landowners on the downstream side of the canal. It was recommended that bids for this culvert be held until a careful investigation could be made but they were rejected by the Director.

FARM CREEK DIVERSION CHANNEL, EAST PEORIA.

Work was continued on the design and drawings for this work in conjunction with the Toledo, Peoria & Western Railroad. After many delays caused by the dilatoriness of the railroad company, plans and specifications were finished, proposals called for and opened on March 24, 1930. A copy of the canvass of bids is attached.

After the bids were opened the Highway Division of the Department of Public Works and Buildings declined to approve the plans and would, therefore, not allow Highway No. 8 crossing the site to be closed. Also the T. P. & W. R. R. refused to cooperate further, so revisions were made in the design of the channel to satisfy the Highway Division engineers and the work readvertised with the railroad portion omitted. Bids were opened on May 12, 1930. A copy of the canvass of bids is attached. The contract was awarded to the lowest bidder, Porter & McCully of Lexington, Illinois, who started work as soon as their bond had been approved.

FARM CREEK DIVERSION CHANNEL BRIDGE, EAST PEORIA.

A bridge to carry Highway No. 8 across the Farm Creek Diversion channel was designed by the Highway Division for the Division of Waterways at the request of the latter. Proposals were called for and opened on February 5, 1930. The contract was awarded to the lowest bidder, the Milwaukee Bridge Company of Milwaukee, Wisconsin; a copy of the canvass of bids is attached.

ANNUAL REPORT JOLIET DIVISION.

By Ralph S. Heath, *Division Engineer.*

PROJECTS 5 AND 6.

Projects 5 and 6 covering the construction of the Brandon Road Lock and Dam and the Brandon Road Pool, under the supervision of Green & Sons Company, of Chicago, progressed very favorably during the first half of the fiscal year. In fact the work accomplished during the full season of 1929 was equal to twice the total of the average lock on the waterway. However, due to a shortage of sufficient funds to carry on all the projects on the waterway, very little work was done after January 14, 1930, at which time orders were received to suspend all but essential

work. The only items of work authorized under this head were the completion of the sewer sections of the east wall at McDonough Street and the 36-inch cast iron sewer connecting the two trunk lines in the east and west walls below McDonough Street. This was deemed necessary in order to accommodate sewage from the new trunk line sewers under construction by the city of Joliet, which were to be completed in the Spring of 1930.

PROJECT 5—BRANDON ROAD LOCK AND DAM.

Excavation.

The only excavation progress to report is the completion of the last third of the ice protection wall, the ice chute, and flood sluice gates, one unit of the spillway on the west and the rock for the spillway on the east side of the river. The center berm and lower sill of the main lock planned for the winter was suspended when the general order to close down was received.

Concrete.

Proceeding with two to four paving mixers during the 1929 season the following sections of the work were completed:

The last section of the sill, the balance of the piers and all but one section of the top girders of the head gates; all of the ice chute except 63 cubic yards in the top sections; all except 131 cubic yards of the center third of the flood sluice gates; five and one-half units of the spillway on the east side of the river to elevations ranging from 515 to 525 and one-half unit on the west side adjacent to the flood sluice gates to an elevation of 522; all of the upper approach and ice protection wall and the balance of the main lock except the lower miter sill and emergency dam footings. The last section of the standard wall of the lock was completed on November 14, 1929 and the Blaw-Knox steel forms were dismantled and returned to the owners. The culvert forms were sent to the Dresden Island Lock for use on Contract 3. The balance of the work was built with wood forms made of 2 in. x 8 in. ship lap a good deal of which were of the panel cantilever type.

Cofferdam.

Cofferdams were the same as during the previous year and limited to earth dykes. These dykes enclosed all but about 750 feet of the Des-Plaines River against a head of four or five feet at high stage. Considerable pumping was necessary at these stages but at normal stages a single 6-inch pump easily maintained working conditions within each unit of the cofferdam. A large saving was indicated over the steel sheeting originally considered necessary throughout the larger portion of the river section. It is also believed that the river closure can be made by the same method with the help of a reduced flow from the Sanitary District Canal during the last few days of the operation.

Other items such as channeling, embankment, metal work, etc., progressed satisfactorily. The following table shows the amount of work done to date:

Item.	Quantity completed.	Percentage completed.
Excavation	150,260 cubic yards	54.8
Channeling	52,193 square feet	80.2
Embankment	26,885 cubic yards	31.6
Structural steel	361,462 lbs.	89.1
White oak	2,999 ft. BM	53.1
Steel castings	56,653 lbs.	94.2
Grey iron castings	25,872 lbs.	90.7
Metal reinforcing	294,567 lbs.	96.6
Fibre conduit	3,691 lin. feet	52.3
Concrete	118,194 cubic yards	78.6
Vitrified pipe	1,830 lin. feet	52.0
Wrought iron pipe	823 lbs.	16.7
Total job		72.3

PROJECT 6—BRANDON ROAD POOL.

East Wall.

Excavation and concrete for the east wall was completed from the Junction Line between Contracts 5 and 6 to Allen Street (Sta. 32 plus 31.3 to Sta. 94 plus 11.3) with the exception of the wall at the McDonough Street Bridge (Sta. 75 plus 81.3 to Sta. 82 plus 41.3). Between these stations the sewer section was completed. Also from approximately 100 feet north of the Rock Island Bridge to 107 feet south of the Jefferson Street Bridge (Sta. 99 plus 81.3 to Sta. 110 plus 61.3); and the sewer section only from 76 feet north of the Cass Street Bridge to Benton Street. (Sta. 122 plus 88.6 to Sta. 129 plus 48.6).

West Wall.

Excavation and concrete for the west wall was completed as follows: from the south city limit of Joliet to 123 feet south of the McDonough Street Bridge, (Sta. 38 plus 67 to Sta. 72 plus 27) with the exception of one 30-foot wall section at Lucas Street; from 57 feet north of the McDonough Street Bridge to approximately 100 feet south of the Rock Island Bridge, (Sta. 74 plus 07 to Sta. 87 plus 87); just north of the Rock Island Bridge 390 feet of sewer section and 120 feet of wall section, sewer section—(Sta. 89 plus 37 to Sta. 92 plus 97 and Sta. 93 plus 21 to Sta. 93 plus 57 and wall sec. Sta. 89 plus 37 to Sta. 90 plus 27 and Sta. 90 plus 57 to Sta. 90 plus 87).

Junction Wall.

On the west side a junction wall was built from the Junction Lock north to the city limits, (Sta. 16 plus 59.77 to Sta. 38 plus 67). This wall is completed with the exception of one 30-foot section just north of the lock (Sta. 18 plus 13.41 to Sta. 18 plus 43.41) which was left open to give access to the lock for erection of the gates.

Cast Iron Pipe Crossing.

The 36 inch cast iron pipe sewer crossing connecting the west wall sewer at Lucas Street to the east wall sewer at Duncan Street was completed in May.

Tunnel.

The concrete and excavation in the Public Utilities Tunnel was completed. The sump pump was installed in the east operating chamber. The following utilities have installed their lines in the tunnel: the Western United Gas Company, the Public Service Company of Northern Illinois, the Illinois Bell Telephone Company and the city of Joliet water mains were installed by the State. The tunnel is now filled with water and work is complete with the exception of blower and electric power installation for operation of blower and sump pump.

Water Mains.

The water mains which were required for the city of Joliet are complete with the exception of the connection under the Rock Island tracks on the west side at Railroad Street. Approximately 144 lineal feet of 10 inch pipe with 16 inch incasing pipe are to be laid.

The following is the work done on the various items of Project No. 6, to date:

Item.	Quantity to date.	Percentage completed.
Excavation (tunnel)	3,350 cu. yds.	100.0
Excavation (wall)	134,697 cu. yds.	62.1
Concrete (tunnel)	1,315 cu. yds.	100.0
Concrete (wall)	124,837 cu. yds.	69.0
Channeling	85,163 sq. ft.	52.9
Metal reinforcement	33,578 lbs.	94.4
Structural steel	8,185 lbs.	42.0
Grey iron castings	19,780 lbs.	69.2
Vitrified pipe	607 lin. ft.	36.2
Cast iron pipe	1,291,000 lbs.	88.1
Paving	1,015 sq. yds.	98.0
Total job		68.0

The above work on Project No. 6 was under the supervision of Mr. G. P. Fleetwood, resident engineer.

BRANDON ROAD METAL WORK—PART OF CONTRACT NO. 10.

The contract for the furnishing of the metal work as well as the erection of that part of it not embedded in the concrete progressed very satisfactorily under the supervision of the Independent Bridge Company of Pittsburgh. All of the metal work was delivered on the site by the end of February. The erection, limited to the first half of the fiscal year, consisted of the completion of the four leaves of the upper and guard gates including the riveting and most of the caulking, welding and painting, but not the timber walkways; 20 of the 32 head gates, two of the four lock valves and practically all of the ice chute. A total of 37,670 rivets or 26,285 pounds were driven to date.

CONTRACT 75 PER CENT COMPLETE.

The actual quantities of materials delivered and erected and money earned based upon 60 per cent of the bid price for delivery and 40 per cent for erection (except where erected by others in which case two and one-half cents per pound less than bid price is paid) is indicated in the following table:

	Item.	Unit.	Delivered.	Placed.	Price.	Amount earned.
B.	Pine and fir	M. B. M.	7.639		$ 150 00	
C.	White oak	M. B. M.	13.630	10.035	176 00	$ 1,766 16
D.	Creosoting	M. B. M.	21.269		66 00	662 31
F.	Sand	Cu. yd.	1.22	1.22	5 00	6 10
G.	Structural steel	Lbs.	3,027,132	1,005,745	1195	284,675 05
H.	Steel castings	Lbs.	135,848	70,298	35	41,156 50
I.	Grey iron castings	Lbs.	10,364	11,787	35	2,996 70
J.	Steel forgings	Lbs.	54,142	32,419	35	15,950 55
K.	Special steel forgings	Lbs.	3,332	2,223	35	1,010 80
L.	Monel Metal and nickle steel	Lbs.	9,449	5,658	90	7,139 70
M.	Spring steel	Lbs.	1,926	1,284	15	250 35
N.	Cold rolled steel shafting	Lbs.	432	347	15	59 70
O.	Lead alloy	Lbs.	27,112	8,708	15	2,962 50
P.	Metal reinforcement	Lbs.	372		05	18 60
Q.	Bronze	Lbs.	4,948	3,228	70	2,983 40
R.	Babbitt	Lbs.	18		70	12 60
S.	Wrought steel pipe	Lbs.	273		14	26 18
T.	Wrought iron pipe	Lbs.	16,898	2,576	15	2,015 40
U.	Lock valves	Each	4	2	3,000	9,000 00
V.	Flood sluice gates	Each	6		3,000	12,000 00
						$384,692 60
QQ.	Metal set by others	Lbs. to date	431,842		025	10,796 05
	Total gross earnings					$373,896 55

Based upon $494,000 as the approximate proportionate part of Contract No. 10 the contract is 75.7 per cent completed.

ANNUAL REPORT—OTTAWA DIVISION.

By J. B. Bassett, *Division Engineer.*

CONTRACT NO. 2—STARVED ROCK LOCK AND DAM.

Contract No. 2 was let to Woods Brothers Construction Co., of Lincoln, Nebraska, under date of February 5, 1926. It provided for the construction of a lock and dam in the Illinois River, at Starved Rock, near Utica, Illinois.

Construction work was started by Wilson & Company, subcontractors for the excavation, on March 18, 1926. The contract was completed during April, 1930, the final estimate for payment being made under date of April 30, 1930. The details of the operations during the year were as follows:

Weather conditions were good for outside work up to the 20th of November. The balance of November and all of December and January was cold and stormy and unsuitable for work. These conditions did not affect the main operations of the contract as all concrete had been placed. The only delay was in the clean-up work around the lock and camp sites.

REMOVAL OF COFFERDAMS.

At the beginning of the year the removal of cofferdam No. 3, which was the second cofferdam actually in the river, was under way. It was completed, except cribs in the upstream arm which were left for runway purposes, in July. Cofferdam No. 4, which connected cofferdam No. 3, with the rock cliff on the south bank of the river, was being constructed and was finished by August 14. Pumping was started on that date.

Several bad leaks developed but were stopped except one which apparently came through under an overhanging rock ledge. Cribs were arranged in the shape of a sub-cofferdam which led the water from this leak to a sump alongside the upper arm of the coffer. The operation of a pump at this point was continued during the construction work within the enclosed area.

The removal of cofferdam No. 4 and the remaining cribs in cofferdam No. 3 was begun in December and finished in January.

EXCAVATION AND CHANNELING.

Excavation within cofferdam No. 4 was started on August 19 by way of drilling and blasting down the vertical face of the rock cliff on the south bank of the river. The face of the rock wall was made vertical and a key-way was cut about seven feet into the rock, on the center line of the dam, to form a bond. The rock was found to be hard and solid with only one seam, about 10 feet below proposed pool level, which showed soft rock with some moisture.

Excavation in the pit was started September 1 and was carried on slowly during September and October to completion on the last day of October, except for clean-up work ahead of the concrete.

Some of the excavation waste and some of the material from the cofferdam removal was placed as backfill behind the land wall of the lock. It was trimmed up in a general way by January and was finally completed in April.

Channeling by means of line drilling along the upper and lower sides of the excavation was carried on with and in advance of the excavation.

WORK COMPLETED.

Placing concrete in the dam within cofferdam No. 4 was started on October 5 and was continued intermittently to completion on November 23. This completed all concrete work under Contract No. 2.

The work done consisted of the construction of the apron above the dam, pier No. 1 (abutment against the face of the rockcliff), piers Nos. 2 and 3, rollway dam sections in Taintor gate openings Nos. 1 and 2, and two-thirds of the rollway section in opening No. 3. The removal of forms was started by the end of the month and was completed in December.

The necessary reinforcing and structural steel parts were placed in the concrete as the work progressed.

In October the grading and graveling of the permanent road which leads over the waste area and past the lock was commenced. It was continued at intervals to final completion except final dragging, in December.

As the work on the dam was nearing completion the contractor's plant was dismantled and shipment from the site was started. The bulk of plant was removed by January and was finally cleaned up by April except four steel I-beams which are still on the site.

COST OF COMPLETED WORK.

The work done and the amount earned on this contract is shown by the following table:

Classifications.	Quantities.	Amount earned.
Clearing	100%	$ 1,000 00
Cofferdam, pumping, etc	187,000 lump sum	187,000 00
Excavation	480,110 cu. yds.	672,154 00
Channeling	85,576 sq. ft.	85,576 00
Stone paving	90 sq. yds.	153 00
White oak timber	4,689 M. B. M.	820 58
Structural steel	356,461 lbs.	33,863 80
Steel castings	6,361 lbs.	1,017 76
Steel castings	48,551 lbs.	6,797 14
Gray iron castings	17,217 lbs.	1,893 87
Gray iron castings	15,102 lbs.	1,510 20
Steel forgings	109,885 lbs.	21,977 00
Concrete	112,891 cu. yds.	671,701 45
Metal reinforcement	216,646 lbs.	10,832 30
Vitrified pipe, 6-inch diameter	4,212 lin. ft.	1,684 80
Pipe railing and W. S. pipe	5,882 lbs.	2,941 00
Fibre conduit, 3-inch	3,397 lin. ft.	1,019 10
Gravel road	3,826 lin. ft.	7,652 00
30-inch sluice gate	1	350 00
6-inch gate valve	1	30 00
6-inch flap valve	1	15 00
Bronze	428 lbs.	214 00
Extra No. 1, lower approach		46,021 73
Extra No. 2, trunnion box anchor bolts		1,265 00
Extra No. 3, boiler-house pier and slab		650 00
Extra No. 4, control stand for 30-inch sluice gate		86 91
Extra No. 5, vitrified tile bought, but not used		8 20
Extra No. 6, light brackets, approach walls		749 43
Extra No. 7, cofferdam, lower end of lock		16,056 01
Extra No. 8, river cofferdam		25,000 00
Extra No. 9, repairs to cofferdam		153 31
Total		$1,800,193 59
Deduct for removal of lower approach coffer		4,000 00
Grand total		$1,796,193 59

CONTRACT NO 7—STARVED ROCK METAL WORK.

Contract No. 7 calls for the construction and erection of steel work at the Starved Rock lock and dam, consisting of mitre-gates for the lock and Taintor and head-gates for the dam. It was let to the Independent Bridge Company, of Pittsburgh, Pa. The work was started during the latter part of the fiscal year ending June 30, 1928 and has been carried to completion at the end of this year.

Weather conditions were good except during the last third of November, and all of December and January when severe winter conditions obtained. In January the water surface in the river rose, due to an ice jam, and overtopped and partially washed out the cofferdam which had been constructed at the lower end of the lock, and slowly flooded the lock pit. It has not been completely unwatered since that time.

MITRE GATES PUT IN PLACE.

Work on the mitre gates in the lock was resumed at the beginning of the year. The north leaf of the guard gate, which had been washed out of line by the flooding of the lockpit in November, 1928, was straightened. All bolts were loosened, contact faces of steel parts were washed clean, and bolts were re-set. It was found that no damage had

occurred to the steel parts of the gate. Work was carried on continuously on all mitre gates to completion in December except hand rail and minor attachments which were all placed at the end of the year.

AIR-CHAMBERS FOUND NECESSARY.

As the results of tests on lock gates, carried on during the previous year, determined that air-chambers in all lock gates were necessary, the construction of such chambers in the lock gates was started in October. The work was carried on continuously on the four upper gates to completion in January. Air tests were conducted on all four chambers. The one which showed the greatest loss of pressure was then tested with water and was found to be well within the prescribed limits. Water tests were not made on the remaining three gates on account of low temperature, but they were considered to be tight.

During the latter part of January the lock pit filled slowly, by reason of leakage and partial failure of the cofferdam, accompanied by severe freezing. In February the chambers were examined and were found to contain varying amounts of water.

The only explanation seemed to be that the welded seams had partially pulled loose due to the freezing of the gradually rising water which created unequal pressures.

In May the chambers were again tightened by caulking on the inside with gates submerged. Tests showed a very small amount of leakage.

Late in the year the chambers in the lower gates were unwatered by air-pressure and the seams were caulked against water pressure. The work was completed at the end of the year.

LOCK VALVES AND TAINTOR GATES.

Lock valves at the upper and lower end of the lock were set and adjusted.

Some piping in the Taintor gate sills had been placed in conjunction with the construction of the concrete work by another contractor. The erection of the Taintor gate structures was started in September. Trunnion boxes on the piers were first set and lined. This was followed by the placing of the thrust-beams and then the gate structure itself. Riveting, welding of seams and painting followed.

The erection work was carried on continuously except when interrupted by winter weather.

The erection of concrete counterweights was begun in April and one gate was operated. Tests showed that about 5,000 pounds of removable weights on the counterweight beam was the amount needed for a proper balance of the load of the gate.

All operating machinery was installed and the gates were operated. Miscellaneous pipe and fittings were installed and the work was completed at the end of the year.

The ice-chute gate was installed in May and the remaining valves were set in the pier. Trial operations were made by means of a derrick-boat hoist, and final adjustments were made.

Cables for future use in conveying electrical power to operating motors were installed in the conduits previously placed in the concrete.

ALTERATIONS TO GATES AT MARSEILLES.

The installation of air-chambers in the gates at the lock at Marseilles was carried on as a part of Contract No. 7, and was under way at the beginning of the year.

In July the work was temporarily stopped due to hot weather, the sickness of the welders from lead poisoning caused by paint fumes, and the unsatisfactory work by the men.

In August work was resumed with a new crew of men. The hot weather and sickness of the men still caused some delay but the work was carried on continuously to completion on November 15.

The tests for all air-chambers showed a water leakage well within the requirements.

STATUS OF CONTRACT NO. 7.

The classification, quantities and amount earned on the contract were as follows:

Classifications.	Quantities.	Amount earned.
Cofferdams	Lump sum	$ 5,000 00
Pine and fir timber	14,036 M. B. M.	2,105 40
White oak timber	111 M. B. M.	19 43
Wrought iron pipe	38,483 lbs.	5,772 45
Lock valves	4	12,000 00
Structural steel	4,040,447 lbs.	387,882 91
Steel castings	158,166.5 lbs.	31,633 30
Steel forgings	59,176 lbs.	17,752 80
Special steel forgings	3,352 lbs.	1,005 60
Forged monel metal	15,867.7 lbs.	14,280 93
Metal reinforcement	32,209 lbs.	1,610 45
Spring steel	1,926 lbs.	288 90
Cold rolled steel shafting	791 lbs.	118 65
Gray iron castings	10,154 lbs.	3,046 20
Lead alloy	20,413 lbs.	2,041 30
Bronze	1,159 lbs.	695 40
Babbitt		
24-inch gate valves	2	800 00
3-inch gate valves	4	56 00
2½-inch gate valves	3	36 00
2-inch gate valves	2	20 00
1½-inch gate valves	20	160 00
1¼-inch gate valves	381	2,667 00
12-inch sluice gates	10	1,500 00
2-inch radiator valves	6	246 00
Concrete	604.5 cu. yds.	12,090 00
Sand	26.5 cu. yds.	132 50
Creosoted lumber	38,374 M. B. M.	9,209 76
Electric cable	49,912 lin. ft.	14,973 60
Electric cable hangers	368	736 00
Electric cable racks	318	636 00
Electric cable hooks	1,235 lbs.	741 00
Electric cable supports	120	480 00
2-inch fiber conduit	575 lin. ft.	172 50
Type C rubber seal	376 lin. ft.	671 91
Steam hose	1,180 lin. ft.	590 00
4-ply belting	108.8 lin. ft.	32 64
Extra No. 1		49,800 00
Extra No. 2		140,836 13
Extra No. 3		48,115 90
Extra No. 4		5,240 00
Extra No. 5		55,111 09
Total		$830,307 75
Deduction for material not placed:		
Electric cable, 7,878 lbs. at .025	$196 95	
Fiber conduit, 575 ft. at .025	14 38	
		211 33
Grand total		$830,096 42

PROJECT NO. 3—DRESDEN ISLAND LOCK AND DAM.

A contract of employment with the Congress Construction Company of Chicago, Ill., to superintendent the construction of the Dresden Island Lock and Dam by the direct employment of labor, material and equipment was signed December 4, 1928. Work was started on December 10, 1928 and was well under way at the beginning of the present year. In January, 1930, all active operations were stopped except the pumping of the lock pit.

Weather conditions were favorable for construction work from the beginning of the year to about November 20. After that date there were continuous periods of severe cold alternating with mild periods continuing to about February 1. In December a severe snowstorm blocked the roads to the camp, causing almost complete isolation for about two days. During a mild period in January the ice moved out of the Kankakee River and carried away the railroad trestle which ran from the lock site to the gravel pit. It also moved the cofferdam, which was in place around the upper guide wall, and allowed the pit to be flooded.

PROGRESS OF THE WORK.

During the first part of the year the necessary plant was still being assembled. There was received, a mixer-plant for the stationary set-up and one for a floating plant; a one and one-fourth yard excavator, three pumps for unwatering the pit, and twenty two-yard dump cars for hauling gravel. There was built on the site, two material barges, one derrick-barge, one mixer barge, and one towing launch. A shelter for housing caterpillar tractors was erected. Miscellaneous supplies and materials were received. The mixer plants were set up on shore and on a barge.

The construction of a cofferdam, which consisted of two earth and rock dikes extending out from the main shore to Dresden Island, was under way at the beginning of the year. The driving of steel piling in the upstream arm was completed. Pumps were received and the pit was unwatered July 25.

In August two sections of steel cofferdam-sheathing were driven to enclose the site of the main portion of the upper approach wall. In January bad leaks developed in the lower arm of the lock cofferdam during a severe cold period accompanied by a rising river, but prompt action by a repair crew prevented serious damage. The cofferdam was kept unwatered during the entire year.

EXCAVATION.

Excavation on this contract had been begun by the digging of a diversion ditch on the north side of the river to lead drainage water from a culvert under the I. & M. Canal to the Illinois River at a point downstream from the proposed dam. This work was followed immediately by stripping earth and gravel from the rock surface in the lock and Taintor gate sections.

The excavation of rock was begun in the Taintor gate section and was continued in the lock section around the upper gate locations and along the river wall of the lock. The work was completed in that por-

tion of the Taintor gate section which lies within the present cofferdam enclosure. The cut-off trench under the dam was deepened below projected depth at the suggestion of the U. S. Engineer office.

Earth and rock excavation was completed along the line of the upper approach-wall for about two-thirds of its projected length.

When operations ceased in January there had been excavated about 66,800 cubic yards of earth and about 28,760 cubic yards of rock. According to the estimates for total quantities, this amounts to about 77 per cent completion for earth and 46 per cent completion for rock.

GRAVEL PIT RAILROAD.

A contract was let for the furnishing of gravel at a pit east of the Kankakee River and a narrow gauge track, including a trestle bridge across the river, was constructed to connect the pit with the site of the work. Delivery of gravel to a stock pile at the mixer was started August 14. During the season about 30,000 cubic yards were delivered.

The embankment which will form a portion of the dam and connect the north abutment of the head gate structure with the Illinois & Michigan Canal bank was finished during July. It was constructed with material borrowed from the right-of-way and was placed in thin layers and thoroughly compacted by tractors which hauled the dump cars. It still remains to be trimmed to neat grade and line.

CONCRETE WORK.

The placing of concrete began in August in four footing blocks for the upper approach-wall piers. This work was followed in September by concrete placed in footings for the upstream sections of the lock walls and in the apron for the Taintor gate portion which lies in the present cofferdam enclosure.

The work was carried on continuously until stopped by cold weather and comprised a total of 23,147 cubic yards placed. In general, the work accomplished was the placing of the Taintor gate apron course, the completion of the upper end of both lock walls back to the guard-gate sections and the partial completion of many sections along the river wall, including nearly all footing for the entire length. The upper approach-wall was partially completed.

METAL PARTS.

Reinforcing steel, castings, structural steel and vitrified pipe were placed in the concrete as the work progressed.

QUANTITY STATUS OF CONTRACT NO. 3.

The progress of the work in terms of quantities to date are as follows:

Classification.	Completed.	To be completed.	Total.
Earth excavation	66,801 cu. yds.	20,195 cu. yds.	86,996 cu. yds.
Rock excavation	28,762 cu. yds.	34,065 cu. yds.	62,827 cu. yds.
Concrete	23,147 cu. yds.	74,785 cu. yds.	97,932 cu. yds.
Earth embankment	19,556 cu. yds.	3,200 cu. yds.	22,756 cu. yds.
6-inch vitrified tile	446 lin. ft.	3,754 lin. ft.	4,200 lin. ft.
2-inch fibre conduit	160 ft.	9,840 ft.	10,000 ft.
Reinforcing	30,722 lbs.	133,278 lbs.	164,000 lbs.
Structural steel	40,138 lbs.	419,298 lbs.	459,436 lbs.

CONTRACT NO. 10—DRESDEN ISLAND LOCK METAL WORK.

Contract No. 10 provides for the furnishing of all steel and metal parts, except reinforcing and certain rods and bolts, for Brandon Road and Dresden Island Locks and Dams and for the erection of all metal items not incorporated in the concrete. It was let to the Independent Bridge Company of Pittsburgh, Pa. This report pertains to the Dresden Island portion of the work only.

At the beginning of the year, a derrick for unloading material had been erected and the delivery had only started. During the year nearly all of the material has been delivered and stored, but no erection has taken place due to the lack of sufficient progress of the concrete construction.

PROGRESS OF METAL WORK CONTRACT.

The status of the contract at the end of the year is as follows:

Classifications.	Quantities.	Amount earned.
Pine and fir timber	4,724 B. F.	$ 708 60
White oak timber	3,626 B. F.	638 18
Creosoting lumber	3,563 B. F.	235 16
Structural steel	2,279,221 lbs.	272,366 91
Steel casting	150,654 lbs.	52,728 90
Gray iron castings	72,525 lbs.	25,383 75
Steel forgings	50,999 lbs.	17,849 65
Special steel forging	26,119 lbs.	9,141 65
Forged monel metal	5,663 lbs.	5,096 70
Spring steel	1,156 lbs.	173 40
Cold rolled steel shafting	1,569 lbs.	235 35
Bronze	6,035 lbs.	4,224 50
Galvanized wrought steel pipe	260 lbs.	36 40
Galvanized wrought iron pipe and fittings	21,651 lbs.	3,247 65
Lock valves	2.4	7,200 00
30-inch sluice gates	(1-1,150 lbs.)	600 00
24-inch sluice gates	(1-1,650 lbs.)	520 00
12-inch sluice gates	6	900 00
6-inch flap valves	1	50 00
24-inch gate valves	2	1,000 00
6-inch gate valves	1	75 00
3-inch gate valves	2	30 00
2½-inch gate valves	2	20 00
2-inch gate valves	1	10 00
1½-inch gate valves	11	88 00
1-inch gate valves	157.4	1,101 80
3/8-inch monel metal	54 lbs.	270 00
1-inch steam jet syphon	5.4	81 00
3/4-inch flexible metal hose	54 lin. ft.	108 00
Total		$404,120 60
Deduct for metal work not placed; 459,436 at .02½		11,485 90
Total amount earned		$392,634 70

CLARK'S CREEK CULVERT—I. & M. CANAL.

A contract was let under date of March 17, 1930, to the Peerless Construction Company of Chicago, Illinois, for the construction of a new culvert under the Illinois and Michigan Canal, at Clark's Creek, Utica, Illinois. After some discussion it was decided to place the new culvert alongside the old culvert, which for the past few years had been of too small capacity to carry the run-off from excessive storms, thus providing more than double the original capacity.

Preliminary work started on May 19 and was followed by excavation a short time later. The excavation had been continued only a few days when a rock ledge was encountered a few feet below the bottom grade of the canal. The original plan called for a wooden culvert barrel with concrete headwalls and slope paving. A conference was held between the contractor and the Chief Engineer resulting in a decision to change the plans to provide for a concrete lined culvert.

A new contract was drawn to conform to the changed plan which provided for a lump sum payment of $10,000. The contract was signed on April 9 and the work proceeded rapidly to completion on May 14, 1930.

SURVEYS AND OFFICE ACTIVITIES.

Small surveys and the consequent computations and mapping were carried on principally by Mr. T. F. Levan and the Division Engineer. Assistants for Mr. Levan on surveys were secured from the construction forces when the opportunities occurred. Some office help was secured for a short time from the resident engineer forces from contract work. The projects under this head were as follows:

GOOSE LAKE DRAINAGE.

The so-called "Goose Lake" lies in Sections 10 and 11, T. 33 N., R. 8 E. of the Third Principal Meridian. It was originally a swamp, but has been drained for the excavation of clay for commercial purposes. The elevation of the ground is such that it is subject to overflow from the Kankakee River, except as protected by levees.

The elevation of the proposed Dresden Island pool will either flood or saturate this area, but due to the industrial development, its value is such that a direct purchase for the purpose of overflow would be inadvisable.

Preliminary surveys with two reports have been made, as to advisable methods of taking care of the drainage. The last report recommended an open ditch leading from the area in question westward to the Mazon River, near Morris, and instructions were received for a location survey.

On December 9, 1929, a survey was started and was carried through to completion on February 5 with many interruptions from storms and bad road conditions. All section corners along the line were located for use in right-of-way descriptions. The center line for the ditch was run, cross-sectioned, and additional stadia surveys made.

In the office, notes were reduced, maps were platted and a paper location line was laid out. The line as laid shows the proposed ditch to be about 7⅓ miles long.

A profile was platted with a straight line map showing conditions along the line. The excavation quantities are still to be computed and plats for the purchase of right-of-way are to be made.

SENECA CULVERT.

Surveys were made of a culvert under the Illinois and Michigan Canal, east of Seneca, Illinois, for information in designing a new culvert. Later the surveys were extended above and below the canal to

determine approach and out-fall conditions in the ditches and also to locate areas claimed to be overflowed through lack of culvert capacity. Maps were prepared and blue-prints were forwarded to the Chief Engineer.

KANKAKEE CUT-OFF.

Surveys for overflow areas in the district between the DesPlaines and Kankakee rivers, in Sections 31, 32 and 33, Township 34 N., R. 9 E. and in Section 5, T. 33 N., R. 9 E., known locally as the "Kankakee Cut-Off," had been made the previous year. During this year the notes were reduced and maps platted for the first three sections. The platting of Section 5, and the preparation of overflow plats still remain to be done.

HIGHWAY BRIDGE APPROACHES.

Considerable additional detail data was secured by survey at the approaches to the Treat's Island and Smith's bridges on the DesPlaines River, and at Morris, Seneca and Ottawa, on the Illinois River, to furnish information for bridge approach design to meet the requirements of the United States engineers for the bridges. On the north bank of the river at Treat's Island, the State boundary line was run to determine possible available space for a realignment of the proposed bridge.

The notes were reduced, maps platted and blue-prints were forwarded to the Chief Engineer.

CHANNAHON ROAD.

The State boundary line was run and detail surveys were made for a re-location of the Channahon Road to Smith's Bridge, in Section 16, T. 34 N., R. 9 E. The notes were reduced and maps and cross-sections were platted and the computations for quantities on comparative routes were under way.

ANNUAL REPORT—MARSEILLES DIVISION.

By G. H. T. Shaw, *Acting Division Engineer.*

CONTRACT 9-B, MARSEILLES CANAL.

Awarded to the Callahan Construction Company of St. Louis, Missouri, on July 1, 1929. This company was working full force and had completed during the previous fiscal year about thirty-four per cent of the total amount to be excavated.

Weather conditions were favorable for this work up until January of 1930. On January 6, 1930 the Callahan Company's drag-line machine (Monighan) was shut down on account of bad weather and necessary repairs and did not recommence work until February 26, 1930. The drilling and blasting of rock continued without serious interruption. From February 26, 1930 to April 22, 1930, work was pushed continuously and on the latter date the job was finished.

SUMMARY, WORK TO JUNE 30, 1929.

Item.	Classification.	Cubic yards.	Unit price.	Amount earned.
B–1	Earth	125,000	$0.286	$ 35,750.00
B–2	Rock	270,000	1.00	270,000.00
	Extra Bill No. 1, road change			567.70
	Extra Bill No. 2, property line fence			860.54
	Total earned to July 1, 1929			$307,178.24

SUMMARY OF WORK DURING PAST YEAR.

Item.	Classification.	Cubic yards.	Unit price.	Amount earned.
B–1	Earth	293.494	$0.286	$ 83,939.28
B–2	Rock	475,849	1.00	475,849.00
	Total amount earned			$866,966.52
	Less amount deducted for spoil area			15,000.00
	Total amount paid to contractor			$851,966.52

CONTRACT 9 A, C, D, DREDGING.

This contract is being carried out by the Congress Construction Company of Chicago, Illinois. Under the terms of the contract dated August 3, 1928, the State of Illinois furnished the Congress Construction Company with, a dredge and a complete equipment of tow-boats, barges, etc., commonly referred to as the floating equipment. Full details of the various units of the floating equipment were shown in the last annual report. On July 26, 1929 the Diesel engined tow-boat (Patricia Lou Watson) was tested by trips on the river. On August 6, 1929 the entire fleet of the floating equipment was in the water of the Marseilles pool and fully inspected. On August 16, 1929 the dredge arrived at Station O of the Morris base line (below Sugar Island) and began excavation of the new channel at that point on August 21, 1929.

The weather and water conditions, since dredging operations were commenced, have been seasonably favorable. Very few "shut-downs" were necessary until the month of January, 1930, when extreme cold weather and high water prevented the dredge from operating more than ten days during that month.

Since August 21, 1929 the Congress Construction Company has completed the new channel from Station O (Morris base line) to Station 207, which is about one-half mile above the highway bridge at Morris, Illinois. The dredge is now working on the section from 207 to 230. All of the material excavated, with exception of a few boulders, has been earth, sand and gravel.

SUMMARY OF WORK DONE TO JUNE 30, 1930, IN MARSEILLES POOL.

Station 0 to 207	192,642	cubic yards	@ $1.00—	$192,642.00
Station 207 to 230 (partial)	23,000	cubic yards	@ 1.00—	23,000.00
Totals	215,642	cubic yards	@ 1.00—	$215,642.00

STARVED ROCK AND DRESDEN ISLAND POOLS.

No work has been done in these pools during the year, but during the previous fiscal year the contractor with their own equipment excavated 87,615 cubic yards of rock and earth in the Marseilles pool, and 102,900 cubic yards of sand, gravel and earth in the Dresden Island pool.

STREAM POLLUTION AND SANITATION.

By M. C. Sjoblom, *Sanitary Engineer.*

During the past year 18 permits have been issued for sewage disposal plants or sewerage systems. The number shown is rather small compared with that of former years, but reflects no doubt the general depression in business and construction during the past year or more. But the issuing of permits was not the only work carried on. Several investigations were made throughout the State in order to study existing unsatisfactory conditions complained of and to pass on situations affecting this department directly. A few instances will be cited.

DISINTERESTED SERVICES RENDERED.

Some time ago Elmhurst, Villa Park and Addison voted to create a sanitary district taking in most or all of the territory in the three towns. But though these adjoining municipalities favored a sanitary district there were many people who objected to proposed heavy expenditures for a new sewage disposal plant to supplant seven existing plants, some of which have not as yet been finally paid for. As a result of these objections, the writer was asked as a disinterested party to study the situation and report whether or not the proposed new plant was necessary. This study was made and it was found that existing plants were inadequate, some of them poorly situated and all in all something had to be done. A new and properly designed and located plant seemed the only reasonable solution and it was thus reported. It might be of interest to note that this Division at the time they were proposed advised against the sites of some of the plants now about to be abandoned.

AIDS WATERWAY WORK.

During the year the writer was selected to pass on questions of damages in connection with the condemning or purchase of certain property by the State for the Illinois Waterway. In one case it was claimed by the owner that damages to his well would follow the raising of the water level in the river. However, a study of the situation and an analysis of the present water supply indicated conclusively that no damage would result from the raising of the water.

WORKMEN PROTECTED.

Another study was made for the State at the Dresden Island works. The State had sunk a well and had been using the water for sometime when a periodic analysis by the State Water Survey indicated a polluted water. Great alarm was registered by the workmen and precautionary measures taken at once. A study of the local situation by the writer indicated that the supply was not apt to be polluted and it seemed quite reasonable to believe that the pollution had found its way above ground in preparing the water for shipment. Further samples were sent away for analysis which indicated a safe supply.

MANY INVESTIGATIONS MADE.

Among many complaints received was one from the North Shore Mosquito Abatement Society alleging that a long pond on the grounds

of the Glenview Golf Club was the source of mosquitoes in that vicinity. It was stated that the lake was poorly maintained, with grass and weeds in the water difficult of removal and the weedy spots so located that it was impossible to oil the surface. Investigation seemed to indicate that the complaint was not well founded and from all appearances the lake constitutes an asset rather than a liability to the community.

Another investigation was made as the result of complaints alleging damage from oil wells near Flat Rock, Illinois. Numerous property owners filed a petition requesting that the State take action toward curing some of the bad features and practices now found and practiced in connection with the oil production. A study in the district in question showed that damage is being done to a large number of persons who own land near the oil wells. No doubt largely through carelessness large quantities of oil are permitted to find their way into the nearby streams, thus making the waters unfit for watering stock and in many cases covering the banks with oily deposits.

OIL COMPANIES—OFFENDERS.

Repeated complaints to the oil companies have apparently brought no relief. Only through litigation can those damaged hope to find relief. Unfortunately in most cases the farmers who are damaged have little money for law suits and the damage continues.

There are also large quantities of salt water being pumped into the streams which render the streams unfit for domestic water supply purposes. Fish life too is being destroyed by the oily wastes. A general conference of all interested parties might help to a better understanding and tend to bring about some plans for relief.

The above represent several typical cases of investigations which show the varies nature of the complaints and work. Numerous other conditions have, however, arisen, each in turn requiring technical study and recommendation for action.

FLOOD RELIEF REPORT.

By L. C. Craig, *Division Engineer.*

This report for the year ending June 30, 1930 covers flood relief work done under all Flood Relief Acts passed by the Fifty-sixth General Assembly.

Flood relief work under these acts consisted of the repair and enlargement of levees, the construction and repair of outlet ditches and channels and other flood control works. Work proposed and under contract is located on the Illinois and Mississippi rivers and along several of the interior streams of the State.

ENGINEERING ORGANIZATION AND METHODS.

The investigation of flood relief applications during the year has been carried on by the writer with headquarters at the Chicago office.

The investigation of these applications necessitated a visit to each project and an inspection of the site of the proposed work and of plans made by local engineers. Applicants for relief, commissioners of drainage districts and interested land owners were interviewed in each case.

In all, 47 applications were received during the year, of which 28 have been investigated and reports made to the chief engineer.

EAST PEORIA OFFICE MOVED TO BEARDSTOWN.

The office opened in East Peoria October 1, 1928, for the purpose of taking care of flood relief work along the Illinois River, was moved to Beardstown May 31, 1930. The work carried out by this office has consisted of necessary surveys and inspection of damaged levees and the inspection of work under contract.

LOCAL OFFICE OPENED AT HARRISBURG.

May 1, 1930, an office was opened at Harrisburg, Illinois, with M. C. Lewis as resident engineer in charge. Two field parties were organized, each consisting of one instrumentman and four helpers. This office will be used to complete surveys and plans for the straightening of the north fork of the Saline River and for several other smaller projects in the vicinity of Harrisburg.

SUMMARY OF WORK ACCOMPLISHED.

The following is a brief summary of work accomplished under each of the flood relief acts:

Of the $219,229.47 reappropriated by House Bill No. 785, $57,097.78 has been expended in finishing eight contracts uncompleted at the end of the last biennium. Three new contracts have been let amounting to $108,903.50.

ILLINOIS RIVER VALLEY.

Of the $1,000,000 appropriated by House Bill No. 654 for use in the Illinois River Valley $54,466.05 has been expended on three contracts. Under this bill five contracts in all have been let, amounting to $92,358.69. As further expenditures under this appropriation will be made largely in cooperation with the Federal government, the State in most cases must await approval by the Federal government of requests for aid before letting additional contracts.

OTHER WORK UNDERTAKEN.

House Bill No. 296 appropriated $600,000 for use along all rivers of the State except the Illinois River and its tributaries. During the year two contracts were let and completed, amounting to $9,353.02. This entire appropriation has been allotted to various projects and surveys, plans and specifications are now being made so that contracts may be let in the near future.

House Bill No. 790 appropriated $30,000 for use in repairing the levees of the Indian Grave and South Quincy Drainage and Levee Districts. Of this appropriation $14,119.86 remains unexpended.

ANNUAL REPORT—HYDRAULIC DIVISION.

By Murray Blanchard, *Hydraulic Engineer.*

REAL PROPERTY INDEX MAPS.

The card record of right-of-way property purchased or required for The Illinois Waterway was continued.

A set of cards was made for Illinois Waterway property leases, giving the descriptions, lessees, terms and other information regarding leased tracts.

A set of 42 mounted maps of The Illinois Waterway right-of-way property on a 200 foot scale and colored, to show submerged areas and other areas which will be at higher elevations, was continued and completed to date except for the inking of some data that is entered in pencil.

Special small scale maps were prepared, as follows:

(1) A map showing the locations of Illinois Waterway property purchased and required.

(2) A map showing location of Illinois Waterway property leased.

(3) A map showing the location of Illinois and Michigan Canal lands leased.

(4) A map showing the locations of Illinois Waterway lands that will be rentable or saleable when the waterway is completed and the pool areas submerged.

HYDRAULICS.

A discharge measurement of the Illinois River at Morris was made by the writer and the District Engineer of the U. S. Geological Survey in August, 1929, when the river was at an extreme low water level. The discharge was 6,500 c. f. s.

A series of slope observations of the Marseilles pool were made by Division Engineer Patrick under the direction of the writer. These were made when the discharge of the river was small and at various stages up to a 17,000 c. f. s. flow. The lowest profile observed was for a flow at Morris of 5,300 c. f. s. The discharge measurements were used in a revision of the Morris rating curve for low stages. The profiles were used in the determination of coefficients to use in the revision of backwater curves.

The slope observations were made primarily to determine accurately the flow line for 6,000 c. f. s. to which the channel excavation is referred.

Calculations were made to determine the high and low water clearances for bridges that are being designed over The Illinois Waterway.

Miscellaneous hydraulic problems were solved for the Designing Department in connection with spillways and various structures.

CHANNEL EXCAVATION SHEETS.

The writer directed the work of the Marseilles Division Engineer office in the preparation of cross section sheets and the calculation of channel excavation quantities. The cross section areas from Station 0 to Station 90 of the Morris Base have been submitted and checked. Considerable dredging beyond these limits has been done for which the cross section sheets have not been prepared.

The channel alignment shown on four sounding sheets prepared by the Division Engineer has been approved by the U. S. District Engineer. This extends from Morris Base Station Zero (Woermann Station 1371) to Station 300 (Woermann Station 1401).

FLOOD CONTROL REPORT.

Proofs for the 400 page, cloth bound, Flood Control Report, dealing with the flood situation in this State, were read and corrected, as and when submitted by the Division of Printing. The final proof sheets of the entire book were recently read and returned to the Superintendent of Printing.

STORM DAMAGE—OBSTRUCTIONS—PERMITS.

By W. G. Potter, *Drainage Engineer.*

LAKE MICHIGAN SHORE LINE.

At the end of the last fiscal year, Lake Michigan was at its highest stage for 43 years past. The mean lake level for June, 1929, was at elevation 582.22. In July and August, 1929, the stage rose slightly to elevation 582.33, but in the following months the annual fall and winter decline brought the lake level down until, in February, 1930, it reached a stage of 580.58. Since then the water has been rising again, but this

Jackson Park, Chicago. Unloading bucket of small stone for new breakwater.

time very slowly, and the summer stage is not expected to be as high as in 1929. In May, 1930, the mean level was 580.99 which is 1.03 feet below the mean level of May, 1929.

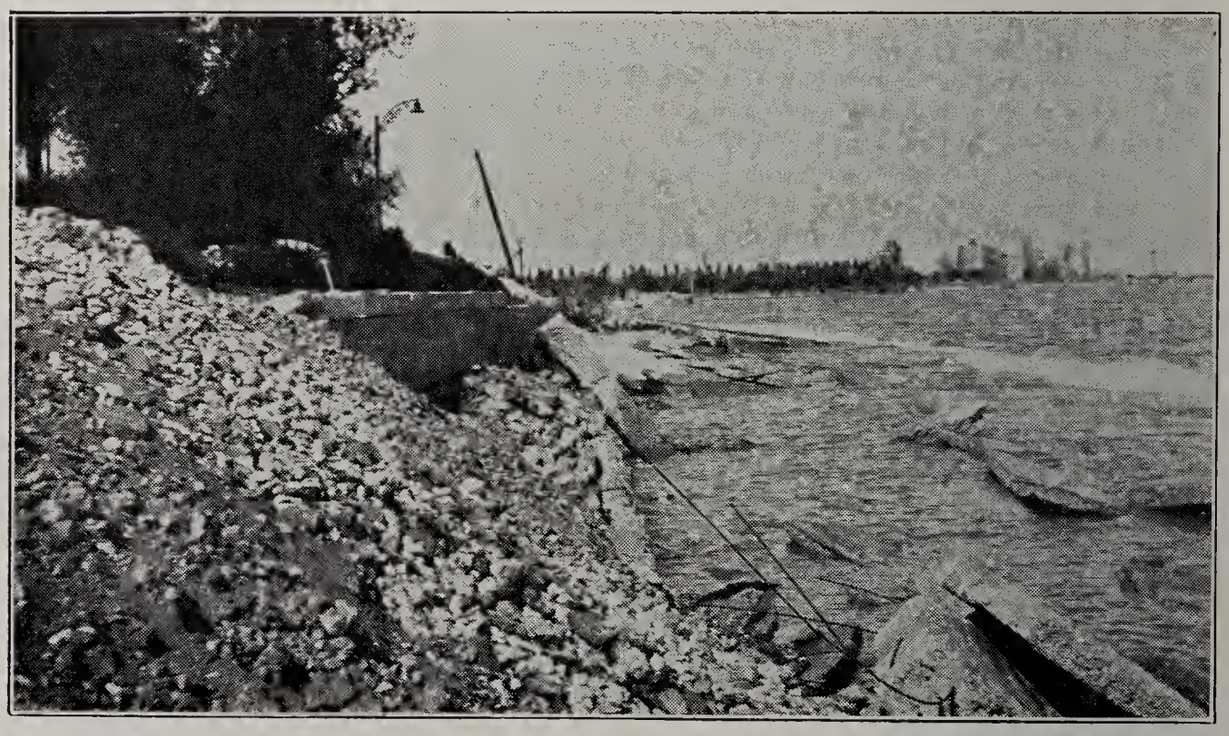
Much of the extremely high stage of last year was caused by the excessive amount of water passed through the controlling works at Sault Ste. Marie in order to lower the level of Lake Superior. On Lake Superior, the stage steadily lowered from August, 1929, and not until May, 1930, did the usual spring rise develop.

STORM DAMAGE TO SHORE LINE.

During the summer and fall of 1929, several very serious storms occurred on Lake Michigan, which caused much damage to public and

private properties along the shore. Piers, jetties and bulkheads were destroyed. Large apartment buildings erected close to the water line were subjected to heavy vibration from the force of the waves, and in some cases were even threatened with the undermining of foundations. Very serious damage was also caused to the roads, boulevards and shore walls of Jackson Park, Grant Park, Lincoln Park and the Evanston Parks.

In consequence of these damaging storms much shore protection work has been necessary all along the shore from South Chicago to Waukegan. Two outstanding improvements in the methods of shore pro-



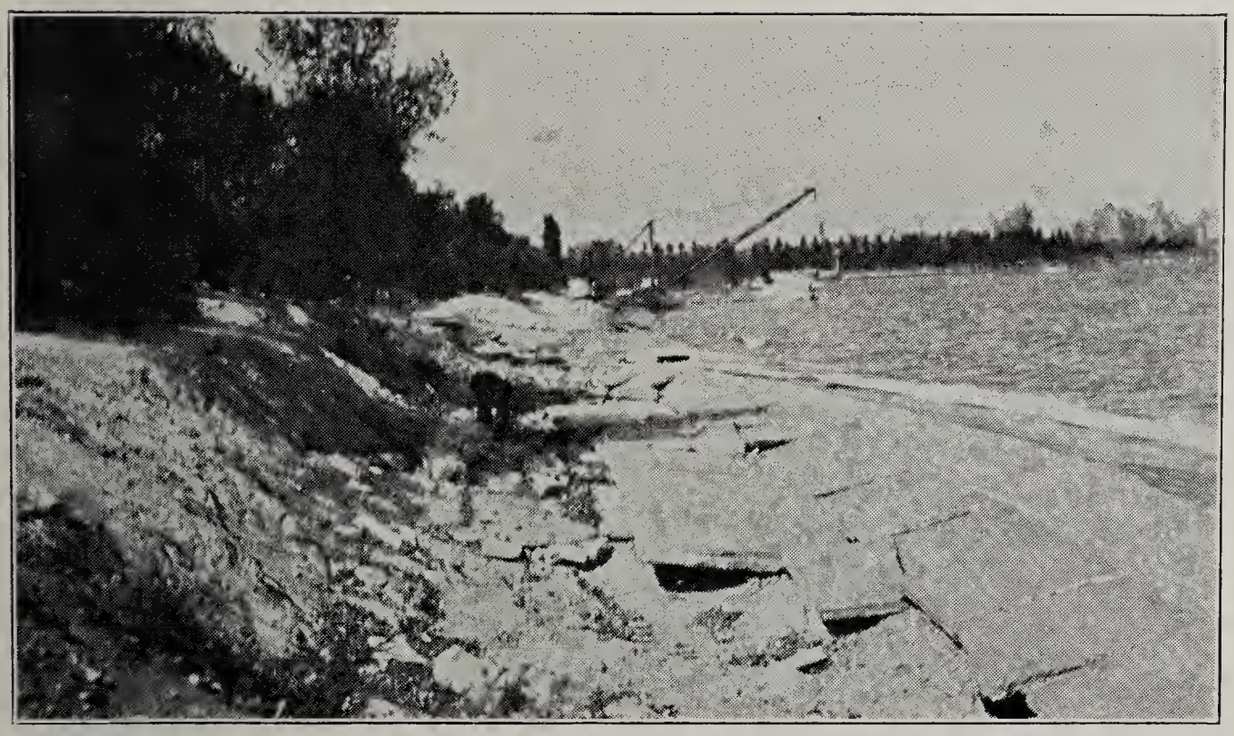
Jackson Park, Chicago. Damage from storm in October, 1929.

Jackson Park, Chicago. Stone breakwater being constructed due to storms in 1929.

tection which have developed during the year past are, first, the increasing use of concrete construction for bulkheads; second, the protection of timber bulkheads and jetties by the use of heavy steel sheeting driven deep into the underlying clay on the north and east sides of the timber to protect from the heavy northeast storms.

SHORE LIMITATION LINE.

During the past year, by an opinion of the Attorney General, the attempted shore limitation line as established by the Rivers and Lakes Commission, commonly called the "1914 line," was declared invalid.



Jackson Park, Chicago. Storm damage of October, 1929.

Jackson Park, Chicago. Damage from storm in October, 1929.

In place of this the limitation line was fixed by the opinion, in accordance with the decision of the State Supreme Court in the Knox case, as follows:

"That along the shores of Lake Michigan, the boundary line of lands adjoining such lake, is that line where the water usually stands when unaffected by any disturbing cause. Neither high water mark nor low water mark should be considered such boundary line."

In line with that opinion, all applications for permits for shore protection extending into the water now include a waiver by the owner of claim to any land that may accrue to him beyond the water line as above described, by reason of such construction.

PECATONICA RIVER SURVEY AT FREEPORT.

This survey was completed during the month of July, 1929, and the full report thereof is included elsewhere in this volume.

Jackson Park, Chicago. Damage from storm, October, 1929.

HENDERSON CREEK IN HENDERSON COUNTY.

A personal investigation of part of this creek was made in Bald Bluff Township, Henderson County, by request of several land owners who desired a change of channel to improve a very roundabout course in the present channel. Their plan was approved and a permit was issued for a change of channel reducing a river length of over three miles to a length of one and one-third miles.

CROW CREEK IN HENRY COUNTY.

A personal investigation of this stream was also made at the request of property owners. Crow Creek is a small stream with outlet into the Illinois River below the town of Henry. The part of the stream in question is some five miles above its mouth. It was found that this is a very meandering part of Crow Creek, flowing through gravel banks which erode very easily with each high water. In consequence, the

stream bed fills up and is very shallow so that the water often overflows its banks and floods adjacent farm property. The opinion given to the property owners was that in order to relieve the flood danger, the stream would have to be straightened and deepened from its mouth up beyond the limits of the gravel banks. This would mean possibly ten miles of channel to be improved, and could best be done by the formation of a drainage district.

DESPLAINES RIVER INSPECTION.

In August, 1929, several letters were received from the DesPlaines Valley Mosquito Abatement District in regard to the condition of the river with respect to sewers discharging into the stream and the consequent formation at times of low water of pools which form excellent breeding places for mosquitos.

Following this, the writer made an investigation of the river from the Hoffman dam at Riverside to North Avenue. The water in the river was at an extremely low stage, the stream itself occupied but a small part of the channel and there was very little current perceptible.

Sewers in many cases were discharging their contents on otherwise dry ground at the edge of the stream bed, or into pockets or pools which found their way finally to the stream itself.

The report of the investigation was to the effect that, at times of such low water, the entire stream between the limits above given formed one long breeding place for mosquitos.

RAIL AND RIVER TERMINALS.

Two rail and river terminals were investigated and permits were issued for their construction. One is located on the Mississippi River at Rock Island and one on the Illinois River at Peoria for use on the new Illinois Waterway when completed.

Some preliminary correspondence also occurred in regard to another terminal on the Illinois River at Pekin.

MISCELLANEOUS INVESTIGATIONS.

Frequent visits were made to Rockford, Dixon, Sterling and other points on the Rock River, often in conjunction with the U. S. Associate Engineer, in regard to permits requested, to encroachments of various kinds, or to shore walls and limitation lines. One outstanding improvement on the Rock River is the construction of over 1,400 lineal feet of concrete shore wall on one property at Rockford.

On the Fox River also numerous visits were made to Elgin, Aurora and other points in regard to permits or encroachments.

WORK OF INSPECTORS.

Inspectors were maintained during the year as follows, their duties being to make regular inspection trips over their territory looking for encroachments, pollutions, etc., and inspecting work done under permits.

One inspector on the Illinois River, one on the Rock River, two on the Fox, one on the Calumet, one on the Chicago River, one on the DesPlaines and one on Lake Michigan shore line. During the year the

regular inspection on the Kankakee River was discontinued and one new inspector was appointed whose territory includes part of Lake Michigan shore line and part of the lakes and inland streams formerly under the Fox River inspector.

OFFICE WORK.

Routine work on permits; authorizations for sale or lease of Sanitary District lots; office investigations of flood capacity of bridges for which permits were requested and for which field investigations was unnecessary; compiling rainfall data at all U. S. Weather Bureau Stations in Illinois; charting of discharge of streams, and miscellaneous correspondence.

PERMITS ISSUED.

The permits issued during the year were as follows:

Bulkheads, piers, jetties	47
Shore walls	15
Docks (3,112 linear feet)	17
Bridges	38
Drainage districts	5
Transmission lines or cables over or under rivers	17
Pipe lines under rivers	16
Harbor lines	2
Dredging or filling in rivers	21
Sewers and treatment plants	18
Dams and lakes	8
Miscellaneous	4
Total formal permits	208
Permits on weekly list from Division of Highways	317
Total permits issued	525

ILLINOIS AND MICHIGAN CANAL REPORT.

By John A. Walter, *Auditor and Collector.*

SUMMARY OF SPECIAL CANAL FUND.

July 1, 1929, to June 30, 1930.

Balance on hand July 1, 1929		$71,481.96
Receipts as below	$33,502.13	
Expenditures as below	23,229.44	
Receipts over expenditures	$10,272.69	10,272.69
Balance on hand July 1, 1930		$81,754.65

RECEIPTS.

Ninety-foot strip, lots and bridge rentals	$15,159.79
Water power rentals	12,342.24
Boat house rentals	15.00
Water pipe rentals and miscellaneous	5,040.08
Ice leases	795.00
Certified copies	22.60
Tolls and lockages	127.42
Total	$33,502.13

EXPENDITURES.

Appropriation for I. & M. Canal	$23,229.44
Appropriation for Illinois rivers	11,027.02
Appropriation for culvert at Clark's Creek	11,092.56
Appropriation for bridge at Chestnut Street, Ottawa	3,400.00
Appropriation for Culvert at Seneca	381.81

ILLINOIS AND MICHIGAN CANAL EXPENDITURES.

Salary locktenders and officers	$ 9,000.00
Labor pay rolls	10,313.21
Repairs	1,352.23
Maintenance and operation	2,564.00
Total	$23,229.44

MAINTENANCE NAVIGATION ILLINOIS RIVERS EXPENDITURES.

Salary locktenders and inspectors	$3,000.00
Labor pay rolls	4,912.85
Repairs	868.64
Maintenance and operation	2,245.53
Total	$11,027.02

Number of boats running, tolls and lockage collected on the Illinois & Michigan Canal for period, July 1, 1929 to June 30, 1930.

	Joliet.	LaSalle.	Total.
Tolls	$111 08	$16 34	$127 42
Boats cleared	25	11	36

SUMMARY OF ACTIVITIES.

The balance on hand as of June 30, 1930 is $10,272.69, more than was on hand at beginning of the fiscal year and $69,450.37 more than was on hand when the Division of Waterways assumed charge of the Illinois and Michigan Canal on July 1, 1917.

Six new leases for small strips of canal reserve were made and one pipe lease at Ottawa; lease with the Zinc Company at Peru extended for an additional three year period; new switch track lease with the Rock Island and Burlington Railroads at Ottawa being negotiated with increase in rental. Seven leases of canal reserve expired including transformer station near Central Park Avenue, and the structures thereon removed from the reserve strip; eight certified copies of the land and lot sale records furnished.

In March the Illinois Traction started construction of belt line on canal reserve at Ottawa which it is expected will be completed this year.

Boat houses on west bank of the canal between Cass and McDonough Streets at Joliet have been removed account of construction of wall for the waterway.

Leases with the Lemont Refining Company have been assigned to the Globe Oil and Refining Company.

Investigated and made report on Court of Claims damage cases at Marseilles.

Permits issued for transmission lines, gas main and for storm sewer across the canal, also for overflow from tank into canal at Morris.

Refund of $584.45 for paving received from city of Lockport which was transmitted to the department to be credited to General Revenue Fund.

Copies made in duplicate of all canal leases for use by waterway engineers in preparing land location map.

Three additional plates of paint were immersed in the canal near Jackson Street lock and with the others previously immersed, are under observation and examined from time to time.

Samples of water taken from the Illinois and Michigan Canal at three different points and at four different points from the DesPlaines and Illinois rivers and same have been analyzed.

Waterway lock exhibit (Model "D") was sent to Springfield on August 15, 1929.

Canada thistles destroyed on canal reserve in Manilus and Lockport Townships.

Warning signs have been placed on Ruby Street bridge and overhead clearance signs erected on the canal bridges in Joliet and signs being made for all bridges on the canal.

Particular attention has been given to preventing encroachments on the canal reserve and the dumping of debris and refuse in the canal.

New culvert at Clark's Creek, east of Utica has been constructed at cost of $11,092.56. New flooring and stringers installed on Dresden and Aux Sable bridges.

The brush and trees on canal reserve between Argo and Joliet have been trimmed.

The dredging outfit has been kept continuously busy removing bars, fills, deepening the channel and building up towpath between Morris and Lock 13.

New lock gate at Lock 13 constructed and installed and new gate for Lock 14 in course of construction.

Repairs made to locktender houses, lock structures, machinery on dredge boats, barges, towing launch and abutment of Channahon dam.

Channel of the canal, its banks, locks and other appurtenances are in better condition than for many years past except that the eighty-five year old structures are older and more obsolete.

U. S. Coast Guard boat passed through the canal and returned to Jackson Street lock in August, 1929.

On June 21, 1929 the two lower gates in the Sanitary District Lock at Lockport collapsed, and it took until August first for new gates to be constructed and installed. A heavy rain storm caused sand bars, for a distance of one thousand feet to fill the canal channel at Carson Creek and navigation could not be resumed until the bars and obstructions were removed and which took until August 16th.

Navigation closed for the 1929 season on November 25, 1929 and was opened for the present season on June 17, 1930, and boats with draft of not exceeding forty-two inches have experienced no difficulty in passing through the canal.

ILLINOIS WATERWAY LANDS.

Report of John A. Walter, *Collector.*

Receipts from rental of Illinois Waterway lands for the year amounted to $3,464.34.

There is now in effect 18 farm leases in Starved Rock pool and in the vicinity of Dresden, including lease with the Marseilles Golf Club.

The building formerly used by Woods Brothers as office has been rented; one of the houses on the Leland-Bragg tract was rented for a five months period and is now included in a farm lease; the ferry boat at Delbridge Island was rented for two months. During flood in river this spring the ferry broke loose and floated down the Illinois River and sunk near LaSalle.

Canada thistles on some of the Waterway lands were cut and destroyed. The new farm leases provide that tenants destroy thistles and other noxious weeds at no expense to the State.

Repaired one house and barn, and rebuilt fences on three farms in Starved Rock pool.

Appraisal made of lands and property in LaSalle County that will be damaged by construction of the Illinois Waterway, and appraised value of lots and buildings on Jefferson and Cass streets in Joliet, that will be damaged if elevation of bridges is raised.

So that they may be properly cared for, the operating motors and brakes from the new Lockport lock have been brought to the Illinois & Michigan Canal Office, until such time as they are to be used in operating the lock gates.

FUTURE USE OF ILLINOIS AND MICHIGAN CANAL AND CANAL LANDS.

By Wm. F. Mulvihill, *Supervisor.*

The anticipated early completion of the Illinois Waterway, which, in connection with the Sanitary and Ship Canal heretofore constructed by the Sanitary District of Chicago will provide a commercially usable navigation channel connecting the present navigable portion of the Illinois River at Utica with the navigable waters of the Chicago River and Lake Michigan.

Until the Illinois Waterway is completed the maintenance and operation of the Illinois and Michigan Canal, which is the only waterway connection between the Great Lakes and the Mississippi River systems, seems to be an absolute necessity. When, however, The Illinois Waterway is completed, which should not be later than 1933, the question of whether or not the I. & M. Canal should be maintained and operated by the State for navigation purposes is worthy of thoughtful consideration.

PROPOSED CONSTITUTIONAL AMENDMENTS.

Since the Chicago Sanitary and Ship Canal was opened in 1900 several attempts have been made to amend the Canal section of the Constitution of 1870, to permit the sale or long term lease of that portion of the Illinois and Michigan Canal lands lying between Lockport and Chicago. On each occasion the question submitted received the approving vote of the majority of the citizens of the State who voted on the question, but the proposed amendment failed of adoption owing to the constitutional requirement that a majority of all persons voting at the election should be in favor of the proposed change and not merely a majority of those who vote upon the particular question submitted.

On May 26, 1930, at a conference called by the Chicago Regional Planning Association for the purpose of working out, if possible, a plan for the use of a recreation space and driveway of the Illinois and Michigan Canal right of way between Chicago and Lockport, a memorandum was submitted by the Supervisor of Illinois Waterway Construction, in substance as follows:

I. & M. CANAL HISTORY.

On March 30, 1822, Congress passed an Act authorizing the State of Illinois to survey and mark, through the public lands of the United States, the route of the canal connecting the Illinois River with the southern bend of Lake Michigan, and providing that, upon compliance with certain conditions, the bed of the canal, meaning the land required

for the canal, and 90 feet of land on each side of the canal, should be forever reserved from any sale to be made by the United States.

TEXT OF ACT OF 1822.

The text of said Act of Congress of March 30, 1822, is to be found in Volume 3, U. S. Statutes at Large, page 659, and reads as follows:

"Section 1. The State of Illinois be and is hereby authorized to survey and mark, through the public lands of the United States, the route of the canal connecting the Illinois River with the southern bend of Lake Michigan; and ninety feet of land on each side of said canal shall be forever reserved from any sale to be made by the United States, except in cases hereinafter provided for, and the use thereof forever shall be and the same is hereby vested in the said State for a canal, and for no other purpose whatever—on condition, however, that if the said State does not survey and direct by law said canal to be opened, and return a complete map thereof to the treasury department, within three years from and after the passing of this Act; or if the said canal be not completed, suitable for navigation, within twelve years thereafter; or if said ground shall ever cease to be occupied by, and used for, a canal suitable for navigation, the reservation and grant hereby made shall be void and of none effect: Provided always, and it is hereby enacted and declared, that nothing in this Act contained, or that shall be done in pursuance thereof, shall be deemed or construed to imply any obligation on the part of the United States to appropriate any money to defray the expenses of surveying or opening said canal: Provided also, and it is hereby further enacted and declared, that the said canal, when completed, shall be, and forever remain, a public highway for the use of the government of the United States, free from any toll or other charge whatever, for any property of the United States, or persons in their service, passing through the same.

"Section 2. Every section of land through which said canal route may pass, shall be and the same is hereby reserved from future sale, until hereafter specially directed by law; and said State is hereby authorized and permitted, without waste, to use any materials on the public lands adjacent to said canal, that may be necessary for its construction."

(Page 211 of Smith-Hurd Illinois Revised Statutes, 1927.)

THE FEDERAL LAND GRANT OF 1827.

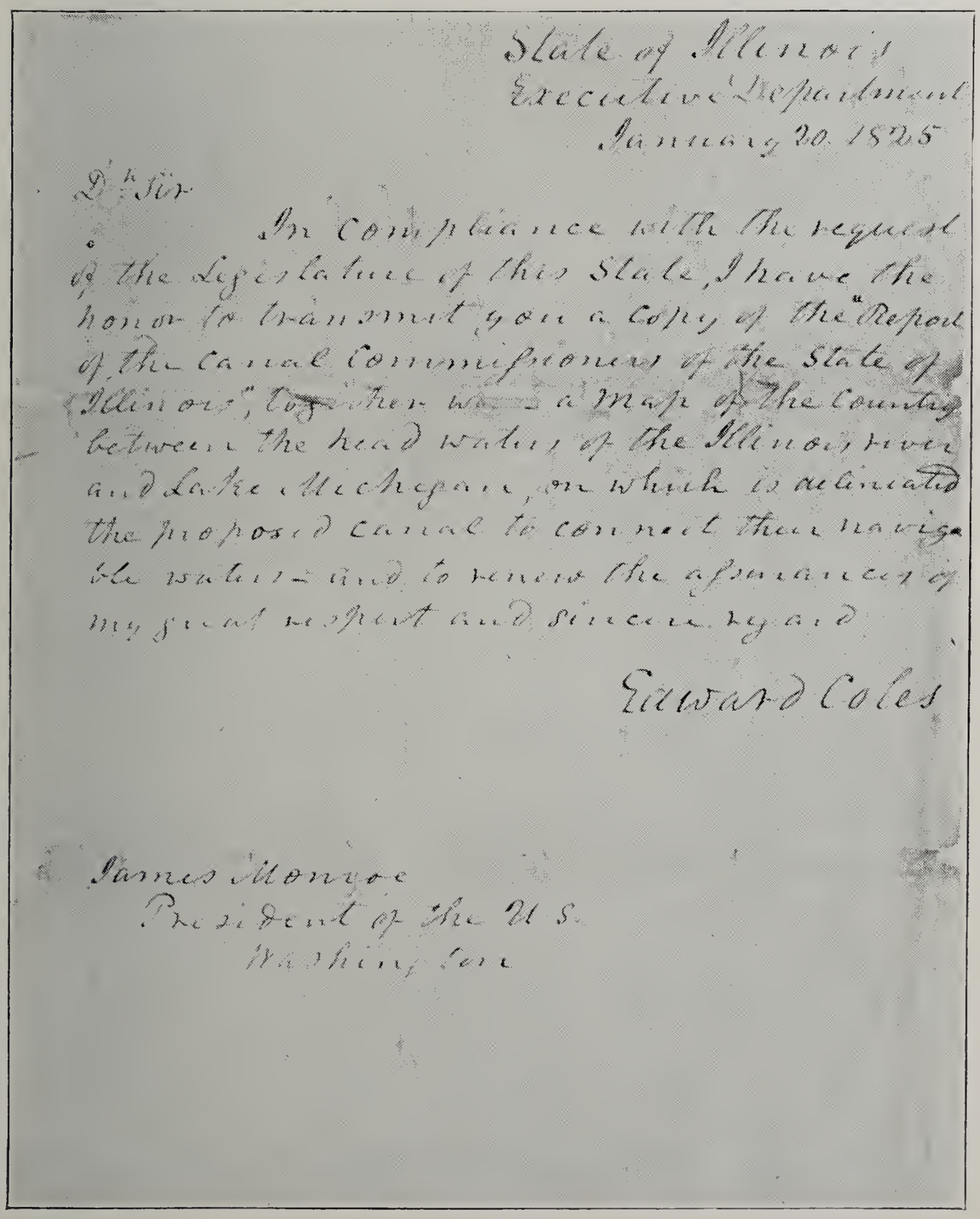
Subsequently on March 2, 1827, at the request of the State, Congress passed an Act which, among other things, granted a quantity of land to the State of Illinois for the purpose of aiding the State in opening a canal connecting the waters of the Illinois River with those of Lake Michigan, said grant being equal to one-half of five sections in width on each side of the route of said canal but reserving each alternate section to the United States.

This Act of March 2, 1827, is found in Volume 4, U. S. Statutes at Large, page 234, and reads as follows:

"Section 1. There be, and hereby is, granted to the State of Illinois, for the purpose of aiding the said State in opening a canal to unite the waters of the Illinois River with those of Lake Michigan, a quantity of land equal to one-half of five sections in width, on each side of said canal, and reserving each alternate section to the United States, to be selected by the commissioner of the land office, under the direction of the president of the United States, from one end of the said canal to the other; and the said lands shall be subject to the disposal of the legislature of the said State, for the purpose aforesaid, and no other: Provided, that the said canal, when completed, shall be and forever remain a public highway for the use of the government of the United States, free from any toll, or other charge whatever, for any property of the United States, or persons in their service,

passing through the same: Provided, that said canal shall be commenced within five years, and completed in twenty years, or the State shall be bound to pay to the United States the amount of any lands previously sold, and that the title to purchasers under the State shall be valid.

"Section 2. So soon as the route of the said canal shall be located and agreed on by the said State, it shall be the duty of the Governor thereof, or such other person or persons as may have been, or shall hereafter be, authorized to superintend the construction of said canal, to examine and ascertain the particular sections to which the said State will be entitled, under the provisions of this Act, and report the same to the secretary of the treasury of the United States.



State of Illinois
Executive Department
January 20. 1825

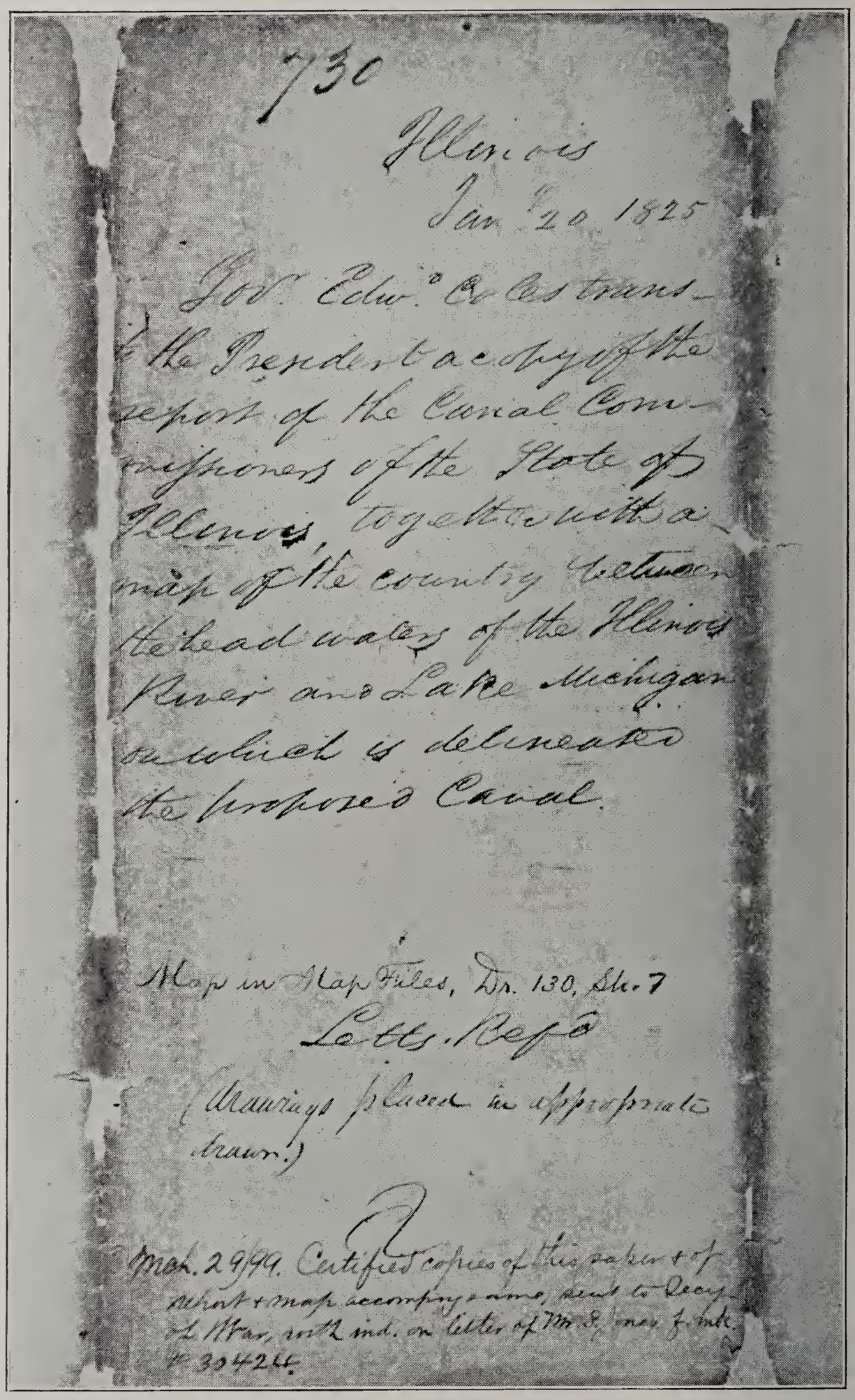
Dear Sir

In compliance with the request of the Legislature of this State, I have the honor to transmit you a copy of the "Report of the canal commissioners of the State of Illinois", together with a map of the country between the head waters of the Illinois river and Lake Michigan, on which is delineated the proposed canal to connect their navigable waters and to renew the assurance of my great respect and sincere regard

Edward Coles

James Monroe
President of the U. S.
Washington

Reproduction of letter, dated January 20, 1825, from Governor Coles to President Monroe, transmitting report and map of I. & M. Canal as required by Act of Congress of 1822.



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Illinois

Jan 20 1825

Gov. Edw.d Coles trans-
to the President a copy of the
report of the Canal Com-
missioners of the State of
Illinois, together with a
map of the country between
the head waters of the Illinois
River and Lake Michigan
on which is delineated
the proposed Canal.

Map in Map Files, Dr. 130, Sh. 7

Letts. Refd

(drawings placed in appropriate
drawn.)

Mch. 29/99. Certified copies of this paper & of
report & map accompanying same, sent to Secy
of War, with ind. on letter of Mr. S. Jones f. mk.
30424.

Endorsements on back of letter from Governor Coles to President Monroe, dated January 20, 1825.

"Section 3. The said State, under the authority of the legislature thereof, after the selection shall have been so made, shall have power to sell and convey the whole, or any part of the said land, and to give a title in fee simple therefor, to whomsoever shall purchase the whole or any part thereof."

(Page 212, Smith-Hurd Illinois Revised Statutes, 1927.)

STATE MEETS PROVISIONS OF ACT OF 1822.

In compliance with the provisions of the Act of March 30, 1822, a survey was made and filed with the President of the United States, James Monroe, and is now in the files of the War Department. See reproduction of letter of January 20, 1825, from Governor Edward Coles to President James Monroe.

Under the Act of March 2, 1827, the canal was laid out and the State selected the odd-numbered sections of land for its land under the grant, leaving title in the even-numbered sections in the United States, subject, however, to the provisions of the Act of March 30, 1822, that the canal and the 90 foot strips should be forever reserved from sale. Subsequently the State sold most of its canal lands and the Federal government sold the even-numbered sections to private owners without any reservation as to the Illinois and Michigan Canal.

CANAL COMPLETED IN 1848.

In 1837, the construction of the canal was commenced and the main channel completed in 1848.

The State claims title not only to the bed of the main channel and canal feeders, but, also, under the grant of March 30, 1822, the State claims title to ninety feet of land on both sides thereof, as "Canal Reserve" property. On the other hand, the successors in title of the original patentees of the land in the even-numbered sections (reserved by the Federal government under the Act of 1827) claim that under the terms of the grants of 1822 and 1827 the State did not acquire a title in fee to the bed of the canal and reserved strips and that by reason of the alleged abandonment of the Illinois and Michigan Canal for navigation purposes between Chicago and Lockport, the title to such canal lands in the even-numbered sections reverted to the Federal government and is now vested in the owners of the adjacent property as successors in title to the original Federal patentees, whose deeds contain no reservation on account of the Illinois and Michigan Canal.

TITLE ABANDONMENT DENIED.

The basis for the claim of abandonment above referred to is found in the fact that on January 17, 1900, the water was turned into the main channel of The Sanitary District of Chicago, thus reversing the flow of the Chicago River and lowering the water level in the river at the point where the Illinois and Michigan Canal connected therewith from 2 to 2½ feet. The then existing pumping works located just west of Ashland Avenue and officially known as the Bridgeport Pumping Station were so designed that they could not pump enough water from the river at this new level to make navigation in the Summit Level of the Illinois and Michigan Canal possible. The sanitary district made certain repairs to the pumping works and for a time after the sanitary

district channel was opened pumped water into the Illinois and Michigan Canal and for sometime after the sanitary district stopped pumping the canal commissioners maintained the navigability of that portion of the canal by pumping. The pumping works were in bad condition and the expense of maintaining and operating them were so large that it was necessary to build new pumping works or abandon the pumping operation.

NO APPROPRIATION FOR IMPROVEMENT.

In 1903 the legislature appropriated $152,950 to provide means of maintaining the Illinois and Michigan Canal in navigable condition and maintaining and operating the Bridgeport Pumping Station, but the Supreme Court of Illinois in the case of *Burke* vs. *Snively,* 208 Ill., 328, held that separate section 3 of the Constitution prohibited the use of State funds, other than surplus earnings of the canal, for the operation and maintenance or the betterment thereof, and enjoined the State Auditor and Treasurer from drawing warrants against or paying out any of the funds so appropriated.

Under these circumstances the operation of the Bridgeport Pumping Station and all canal operations between Chicago and Lockport were suspended.

At the same session on May 14, 1903, the legislature passed an Act permitting the sanitary district to construct the Calumet-Sag Channel across the Illinois and Michigan Canal, using the Calumet Feeder of said canal, to connect with the main drainage channel near Sag. That Act expressly gave the sanitary district the right to construct a channel without being required to restore the Illinois and Michigan Canal or its feeder to their former usefulness.

PENDING LITIGATION.

Under these circumstances abutting property owners in the even-numbered sections along the Illinois and Michigan Canal undertook to assert their claim of title and to fill in the old canal. To prevent such filling and encroachment by owners of abutting private property upon the Illinois and Michigan Canal lands, four suits were filed in behalf of the State in October, 1918, two of these cases being against the Santa Fe Railroad, one against the Dickinson Seed Company, and one against Donnersberg and others.

ONE SANTA FE CASE SETTLED.

One suit against the Santa Fe Railroad was compromised and settled in 1928 (*People ex rel Attorney General* vs. *Atchison, Topeka & Santa Fe Railway Co.*, No. B-46240, in Chancery, Circuit Court of Cook County) whereby the Santa Fe transferred to the State by warranty deed in fee simple about 21 acres of land located on the Chicago River at a point where the Chicago Drainage channel and the river unite. These premises are improved with reinforced concrete elevator with a capacity of a million bushels and by docks, loading platform and railroad tracks. The settlement also provided for construction, without cost to the State, of a channel between the Illinois and Michigan Canal and the Sanitary District Canal and also for the payment by the de-

fendant of $200,000 for further water terminal improvement at such time as the State should be prepared to have such work done.

In exchange for this improved terminal site the State surrendered its claim to the so-called canal lands located in section 30, amounting in all to about 29 acres.

Three of the original suits relating to property in section 36 are still pending and undisposed of. The State has however, prevented any further attempts to fill in the bed of the Illinois and Michigan Canal between Chicago and Lockport, and has at no time legally consented to its abandonment for purposes of navgation.

CANAL STILL MAINTAINED BELOW LOCKPORT.

Below Lockport, the Illinois and Michigan Canal is still maintained as a navigable waterway of the State. It is usable for vessels having a draft of not more than 3½ feet, 16 feet wide and 98 feet long. It is self-sustaining. The receipts for the year ending June 30, 1929 were $36,085.54, being made up as follows:

90 foot strip, lots and bridge rentals	$16,641.42
Water power rentals	12,342.24
Boat house rentals	25.00
Water pipe rentals and miscellaneous	6,104.89
Ice leases	795.00
Certified copies	12.50
Tolls and lockages	164.49
Total	$36,085.54

The expenditures were $28,507.23, divided as follows:

Locktenders and officers	$ 9,000.00
Labor pay rolls	14,224.30
Repairs	712.20
Maintenance and operation	3,307.46
Reconstructing foot bridge	1,263.27

LITTLE ACTUAL NAVIGATION.

During the period July 1, 1928 to June 30, 1929, 42 boats cleared through the canal.

The balance on hand June 30, 1929, was $71,481.96, this is $7,578.31 more than was on hand July 1, 1928 and is $59,177.68 more than was on hand July 1, 1917 when the Division of Waterways assumed charge of the Illinois and Michigan Canal.

The receipts and disbursements for the current fiscal year appear in this report, immediately preceding this discussion.

There is submitted herewith a memorandum prepared by the Chicago Regional Planning Association, regarding the proposed use of Illinois and Michigan Canal lands, for boulevard purposes, between Kedzie Avenue, Chicago and Lockport.

MEMORANDUM ON THE PROPOSED USE.

Ever since the completion of the drainage canal between Chicago and Lockport, which opened in 1900, the Illinois and Michigan Canal has been practically or completely abandoned as far south as Lockport. Efforts have been made by private individuals and public bodies to arrange for the use of sections of this canal and the 90-foot reserve on each side, for manufacturing or other purposes.

The direction in which the canal lies is from close to center of a vast population on the south and west sides of Chicago in a southwesterly course toward the DesPlaines River, forest preserves and the 8,000 acres of county forest preserves on Mount Forest and Palos Hills. These recreation acres, already used by many of Chicago's people, would be more available were there a recreation type of driveway in this canal property leading at least from Kedzie Avenue southwest to the mouth of the Sag and eventually being extended to Lockport and even to Joliet.

CONTEMPLATES MAINTENANCE OF 30 MILE STRIP.

The present proposal contemplates the maintenance of the canal and the canal reserve from 240 to 270 feet in width as a continuous strip of land with no interruption, so that if it ever becomes necessary to revert to the use of the canal and the canal reserve as a waterway, that may be done.

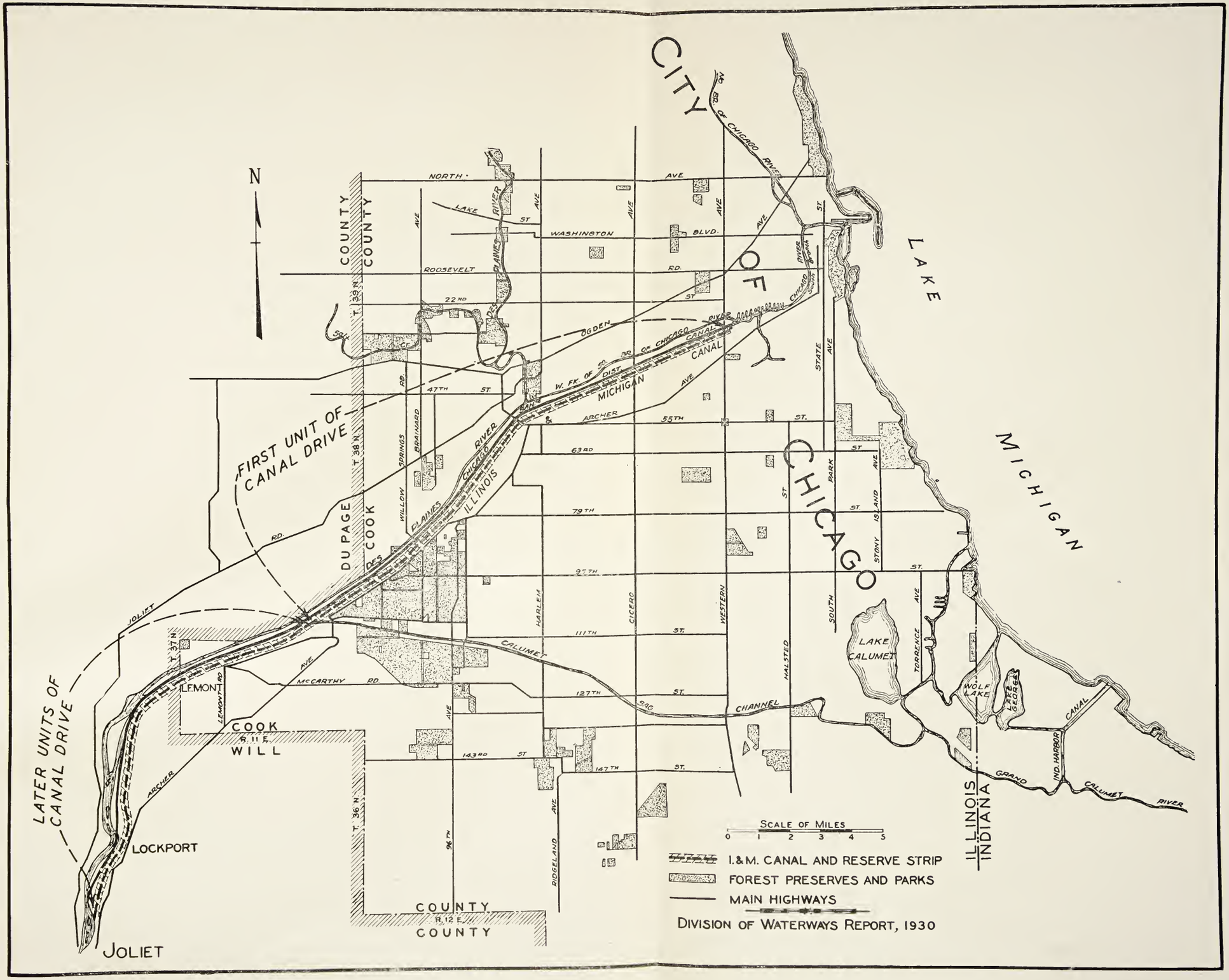
The point in favor of this proposal is that the property is not broken up into separate parcels either by sale or lease to private, semi-public or public agencies. The plan contemplates no change in the title of the land which now rests in the State of Illinois and is administered by the Department of Purchases and Construction, Division of Waterways. It is proposed that permission be granted by the Department of Purchases and Construction to the Department of Public Works and Buildings for the construction of a paved driveway in the bed of the canal by State or State aid highway funds. To do this construction work would require first the drainage of the canal and a minimum amount of grading so as to disturb the canal banks practically not at all. The advantage of this type of construction rather than a type which would involve the filling of the canal is that the traffic on this driveway would be separated at every intersecting railway and highway by passing underneath it, the bridges all now being in existence.

BENEFIT TO WEEK-END AND HOLIDAY TRAFFIC.

The advantage to the people of the State of Illinois and to those of Chicago and its metropolitan area would be that a driveway of unusual value as an aid to metropolitan traffic would be developed and one which would be of particular benefit to the Saturday and Sunday traffic which visits the recreation spaces.

The natural spoil banks of the old canal should remain as they are in most cases because they already bear a considerable amount of foliage as does the bank of the canal itself. Large quantities of picknickers could be accommodated on the canal reserve with parking spaces provided for their cars and in this manner a considerable acreage will have been added to the recreation space so greatly needed by the Chicago metropolitan area.

The legal phases of the matter have been carefully considered and it is agreed by eminent authority, subject to confirmation by the Attorney General, the Director of the Department of Purchases and Construction and the Director of the Department of Public Works and Buildings, that provided no sale or lease of the property is contemplated, there may be permitted a beneficial use of the character described, by the people of the State of Illinois, provided the Federal government sanctions such use.


CITY OF CHICAGO
LAKE MICHIGAN
FIRST UNIT OF CANAL DRIVE
LATER UNITS OF CANAL DRIVE
DU PAGE COUNTY
COOK COUNTY
WILL COUNTY
LOCKPORT
JOLIET
LEMONT
LAKE CALUMET
WOLF LAKE
LAKE GEORGE
ILLINOIS
INDIANA
NORTH AVE
WASHINGTON BLVD.
ROOSEVELT RD.
22ND ST
47TH ST.
55TH ST.
63RD ST
79TH ST.
95TH ST.
111TH ST.
127TH ST.
143RD ST
147TH ST.
McCARTHY RD.
ARCHER AVE
OGDEN
W. FK. OF SO. BR. OF CHICAGO RIVER
DIST. CANAL
MICHIGAN CANAL
DES PLAINES RIVER
CHICAGO RIVER
ILLINOIS
CALUMET SAG CHANNEL
GRAND CALUMET RIVER
IND. HARBOR CANAL
LAKE ST
STATE AVE
SOUTH PARK AVE
STONY ISLAND AVE
TORRENCE AVE
HALSTED ST
WESTERN AVE
CICERO AVE
HARLEM AVE
RIDGELAND AVE
96TH AVE
WILLOW SPRINGS RD.
BRAINARD
LEMONT RD
JOLIET RD.
T. 39 N.
T. 38 N.
T. 37 N.
T. 36 N.
R. 11 E.
R. 12 E.
N
SCALE OF MILES
0 1 2 3 4 5
I.&M. CANAL AND RESERVE STRIP
FOREST PRESERVES AND PARKS
MAIN HIGHWAYS
DIVISION OF WATERWAYS REPORT, 1930

Such a driveway can be constructed with funds which may become available to the county of Cook from the 1927 Gasoline Tax. This work may be planned in 1930 and begun in 1931 provided the necessary sanction and approvals are obtained.

The accompanying map illustrates the park and forest preserve system in the immediate region of Chicago and in a heavy dash line there is shown the section of the Illinois-Michigan Canal which is proposed to be used as a driveway.

THE PECATONICA RIVER FLOODS AT FREEPORT.

By W. G. Potter, *Drainage Engineer.*

The Pecatonica River at Freeport has been subject to periodic floods from time immemorial. Freeport is located at a point where the sharp grades of the upper reaches of the river merge into the much flatter grades of the lower river, and the velocity of the stream is consequently much decreased. The valley of the river is low and the banks of the stream are but a few feet above the water. Due to this, to the tortuous and narrow course of the stream below Freeport, and to the sediment deposited by the slower current, the rushing flood waters from the upper river, not having a sufficient chance to get away, are bound to pile up and overflow the banks.

East Freeport, which contains much of the manufacturing district and its accompanying homes, is located on comparatively low ground and has repeatedly suffered damage and loss of working time from the flood waters flowing through streets, factories and residences.

THREE SURVEYS HAVE BEEN MADE.

This department, or its predecessors, has made three intensive surveys and studies to determine the best and most practical way to prevent this damage, which is almost annually either threatened or actually occurs.

In 1916, after a flood of 17,000 cubic feet per second, the first survey was made, the report being published in Bulletin 18 of the Rivers and Lakes Commission. This report is now out of print and the supply is exhausted. In 1924, the second survey was made, in charge of the writer of this report, covering not only the vicinity of Freeport, but extending to the mouth of the Pecatonica, and including an estimate of cost of improving the river by cutting off the worst of the bends between Freeport and the mouth. This report may be found in the Seventh Annual Report of the Division of Waterways.

HIGHEST FLOOD STAGE IN 1929.

On March 16th, 1929, the river was again in flood, this time rising to a higher stage than any previous recorded point, the discharge being estimated at 18,400 cubic feet per second.

Following this flood, at a largely attended meeting of citizens, a committee was formed with Mr. G. X. Cannon as chairman, to take action as to the best method of protecting the city from future floods. The State was asked for additional information, and finally the writer

was instructed to make a further investigation and to prepare a supplemental report on the same.

In accordance with these instructions, a survey was made in June and July, 1929, and the report follows:

SCOPE OF THE NEW INVESTIGATION.

The survey for this report included obtaining elevations along the railroads and streets of East Freeport and correlating with them all of the reliable high water marks which could be located; of enlarging our previous stadia survey of the course of the river both above and below

Pecatonica River Floods at Freeport, looking from Illinois Central Depot.

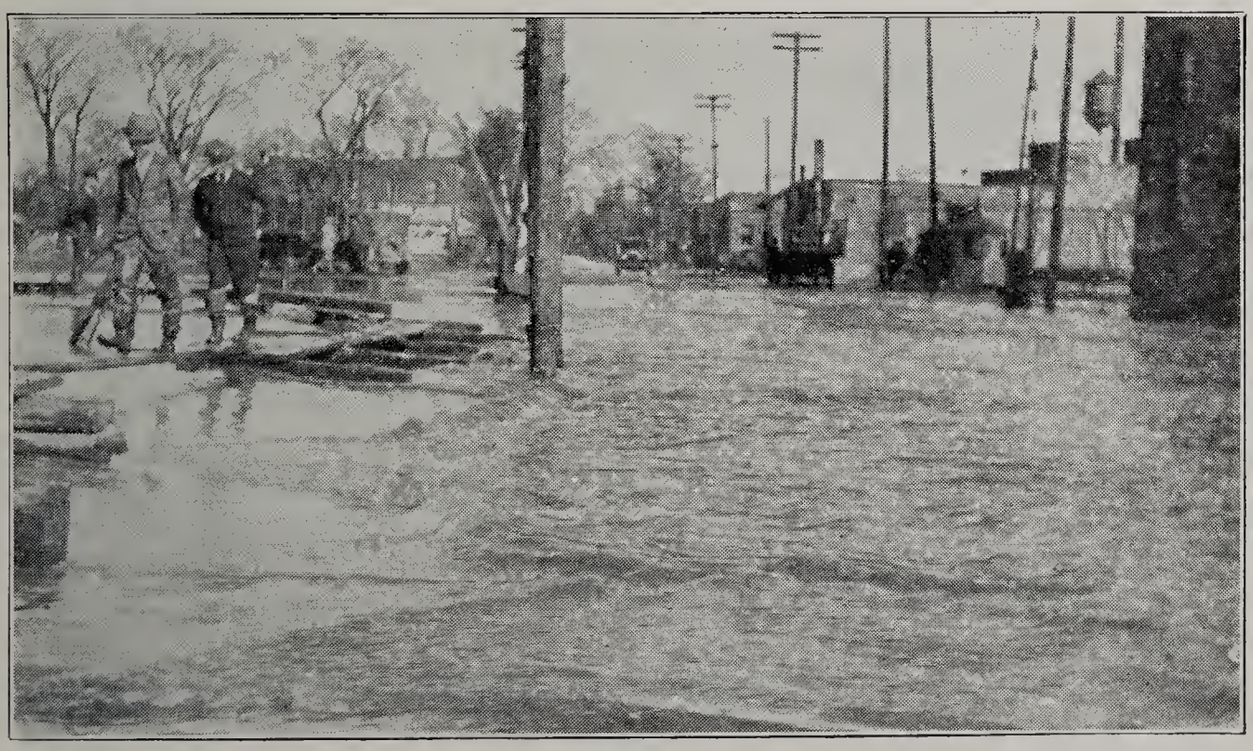
Pecatonica River Floods, 1929, East Stephenson Street, Freeport.

the city, and of taking widths, depths and cross-sections of the present channel in order to make a more complete study of the flood capacity of that channel. Over 150 cross-sections were taken of the river which included soundings and bank heights.

RAINFALL UNUSUALLY HEAVY.

The storm rainfalls at Freeport have been even more severe since 1924 than previous to that time. On June 10th to 15th, 1926, a storm occurred which even exceeded the expected rains in this region, as calculated by the engineers of the Miami Conservancy District, for a 100

Pecatonica River Flood at Freeport. Cedarville Road from Van Buren St. Bridge.



Pecatonica River Flood at Freeport. Near Chicago, Milwaukee & St. Paul Depot.

year period. In this storm 6.19 inches fell in one day; 6.22 inches in two days; 7.12 in three days; 7.66 in four days, and 7.68 inches in five and six day periods. However, in spite of this tremendous downpour, because of the ground being dry and in good condition to absorb the water, the discharge of the river was only 4,500 c. f. s. and was easily cared for in the present channel without overflow.

The flood of March, 1929, was not caused by any excessive rain at that time. During the winter numerous heavy snows had fallen on ground already covered with ice, and extended over all the headwaters of the river. This snow finally melted with a quick thaw, and because of the underlying ice, flowed off very rapidly. Had there been a warm general rain over the watershed at that time the flood would have been much higher and the consequences much more disasterous. In the writer's opinion, in such case, every bridge in Freeport except the Van Buren Street bridge would have been washed away.

ACTION OF THE 1929 FLOOD.

The action of the 1929 flood seems to have been about as follows:

As the water rose, it first overflowed the banks north and west of town, and advanced over the Cedarville road. Simultaneously the water rose over the low bank between the Van Buren bridge and the Goddard Dam. These flows combined and reached the tracks of the Chicago, Milwaukee & St. Paul Railroad. Here they were temporarily stopped until the crest was high enough to go over the tracks.

Finally the water rose above the tracks all the way from the depot to beyond the proposed diversion and washed out several hundred feet of track at the latter point. When the water had crossed these tracks there was nothing to stop its progress until it reached the Chicago and Northwestern tracks east of the bridge of that railroad. Here it was met by another flood flow which broke over the low river bank between the Chicago, Milwaukee & St. Paul and the Chicago & Northwestern bridges and flowed east on the north side of the Chicago & Northwestern road. Again, another flood flow was caused by the water backing up through the small bridge through which the creek from Taylor Park reaches the river.

In consequence of all these flood streams, the water was dammed up by the Chicago & Northwestern track until it finally broke through and again reached the river channel. The water was said to be about two feet higher on the north side of this track than on the south side, before it finally washed out. Undoubtedly the Chicago & Northwestern track had much to do with the extreme height of the flood in that vicinity, and if nothing else shall be done in regard to the recommendations of this report, at least two trestle openings should be made by the railroad to avoid a recurrence of such damage.

In addition to the flood streams above mentioned, a very heavy current crossed the transfer track and crossed Stephenson Street between the bridge and the Chicago, Milwaukee & St. Paul track and returned to the river west of the bridge of that road. This track from the depot to the bridge was out of water.

East Stephenson Street was under water entirely except for about 50 feet each side of the St. Paul track.

SCOPE OF THIS REPORT.

The 1916 report recommended in brief the use of the present channel with a relief diversion channel extending from the present channel at the bend shortly above the Van Buren Street bridge and connecting with the river again near the east end of town where the small stream from Taylor Park outlets. This channel was to be 140 feet on bottom with slopes 1 to 2 and a grade of .01 per cent, and a spillway dam was proposed at the upper end of the diversion, the crest of which would be slightly above the elevation of Goddard's dam, this dam to be retained.

The 1924 report recommended a complete diversion of the river on either of three routes through a 200 foot channel, most of which would practically follow the route of the 1916 channel, but with the diversion channel extending further upstream to cut off two large bends in the river. The outlet of the diversion was to be at practically the same place as in the proposed 1916 channel.

DISCUSSION BASED ON CHANGED CONDITIONS.

The conditions today are materially changed at the upper end by the construction of a high level road across the valley by the State Division of Highways. Whereas, previously, the flood waters spread over the entire valley west and north of the city waterworks, they are now confined by the high fill of this road and must all pass through the five span bridge located near the south side of the valley. This necessarily eliminates Projects "B" and "C" of the 1924 report. There remains, therefore, for discussion, the three following propositions:

1. To widen the present channel to carry the entire flood flow.
2. To divert all flow to the revised Project "A" of the 1924 report.
3. To divert part of the flow and allow the balance to pass through the present channel.

PROJECT 1—USING THE PRESENT CHANNEL ONLY.

To pass the assumed maximum flow of 21,000 cubic feet per second through the present channel, the obvious plan would be to cut a new channel across the bend from the new Route 74 highway bridge on West Street to a point near the Van Buren Street bridge; widen the present channel through the city and eliminate the long bend parallel to the Chicago and North Western Railway by making the short cutoff shown below the Chicago and North Western bridge. These two cutoffs, the first of which would be about 1,200 feet long and the second about 400 feet long, would eliminate around 9,300 feet of narrow, crooked channel.

With these two cutoffs, it would perhaps be practicable to get a new bottom grade of .015 per cent, or a fall of .792 feet per mile.

On this basis, to carry the assumed maximum flow of 21,000 c. f. s. would require a channel of 240 feet bottom width with slopes of one to one and a water depth of 18 feet. At this depth, the top width would be 276 feet, and, for much of the length, additional width would be necessary on one or both sides for berm and levee to protect the land from possible overflow.

CONDITION OF THE PRESENT CHANNEL.

Now let us look at the condition of the present channel. In the 1929 survey, to get more complete information concerning the present channel, over fifty cross-sections were taken between the Van Buren Street bridge and the Chicago & North Western bridge alone. The width of the river from bank to bank is about as follows:

From Van Buren Street to the dam, the minimum width was 115 feet, the maximum was 155 feet and the average was 132 feet.

From the dam to the Transfer bridge, the minimum width is 231 feet, the maximum is 325 and the average is 278 feet. This

Pecatonica River Flood at Freeport. Chicago, Milwaukee & St. Paul Transfer Bridge.

Pecatonica River Flood at Freeport. Stephenson Street Bridge.

short section is, or would be, about all right so far as width of channel is concerned.

From the Transfer bridge to Stephenson Street, the minimum width is 150 feet, the maximum is 193 feet and the average is 171 feet.

From Stephenson Street to the Chicago & North Western bridge the minimum width is 141 feet, the maximum is 192 and the average is 163 feet.

WIDER CHANNEL NECESSARY.

Thus, to obtain the required bank to bank width, the channel would, for the most of its course, have to be widened about 125 feet, and in some places more than 150 feet.

This is not all. The channel between banks is very rounding, and generally the approximately flat bottom is not over 40 feet wide instead of the required 240 feet. Also the river bottom is very irregular in regard to elevation. To get the even grade, as assumed, would require much dredging both to level off the ridges and high spots and to create the required cross-section of the channel.

Another thing necessary, in addition to the extra width required for the channel proper, would be the land for the levees. Levees would be required on both sides of the cutoff, and of the channel from the West Street bridge to the Van Buren bridge. From that point through town to the Chicago & North Western bridge a levee or a concrete wall would be necessary. Below that point, levees would again be necessary on both sides of the channel.

ADDITIONAL RIGHT OF WAY REQUIRED.

These levees, with the berm of at least 15 feet, would necessitate the obtaining of considerable extra land for right of way, which, especially between the Transfer bridge and the Chicago & North Western bridge is quite valuable for manufacturing purposes. With the destruction or removal of the buildings now on this required strip, the expense for right of way would be great.

In addition to the expense for right of way and for the widening and dredging, all of the bridges now spanning the river would have to be much lengthened or else replaced with new ones.

ANOTHER IMPORTANT CONSIDERATION.

Aside from the expense, another very important objection to the plan of passing all of the flood waters through the present channel is the fact that the final outlet, where the flood waters would pass from the widened and improved channel to the present narrow unimproved channel, is so close to town that there would still be danger of the crest height backing up in the channel through the city. This might be avoided by widening the present channel from the end of the short cutoff east of town to cutoff A, reversing the direction of flow in that part of the river and excavating cutoff A. This would make the final outlet at the same point as on Project 2, below the mouth of Yellow Creek.

There are a number of encroachments in the river made by various parties in times past, but with the practical difficulties of forcing the

right parties to remove them, the effort would not be worth while, especially as the gross amount of encroachment would be but a small percentage of the total excavation necessary.

In all of the projects here given, the Goddard's dam is supposed to have outlived its usefulness, and the estimate includes an item for the purchase of its rights and for its removal.

APPROXIMATE COST OF THIS PROJECT.

In the estimate of cost, the amount of excavation must necessarily be only approximate because of the rough bottom between cross sections. Part of the excavation is estimated at 15 cents per cubic yard and part of it at 20 cents, because of the greater difficulty in disposing of the spoil in the built-up district.

The approximate estimate of cost of this project, through the city alone, is as follows:

Excavation, 1,200,000 cubic yards @ 15 cents	$180,000.00
Excavation, 200,000 cubic yards @ 20 cents	40,000.00
Right of way	50,000.00
Buildings razed or removed	25,000.00
Bridges	200,000.00
Goddard's dam rights	15,000.00
	$510,000.00
Overhead 10%	51,000.00
	$561,000.00
Contingencies 5%	28,050.00
Total	$589,050.00

To this should be added for cutoff A and for widening the channel above that cutoff:

Excavation, 850,000 cubic yards @ 15 cents	$127,500.00
Right of way	12,500.00
	$140,000.00
Overhead 10%	14,000.00
	$154,000.00
Contingencies	7,700.00
Total	$161,700.00
Total estimate	$750,700.00

PROJECT 2—TO DIVERT ALL FLOW.

This project was discussed fully in the 1924 report, but is necessarily revised to some extent in this report. Above the upper end of proposed Project A of 1924, the water, as previously mentioned, must now all pass through the West Street bridge because of the high road recently built across the valley. Therefore Project 2 will have to begin at West Street. This means that the present channel will have to be widened from that point to the place where the actual diversion begins.

At the lower end also, the revised plan extends the diversion, by widening the present river channel from the former outlet of the diversion to the upper end of Cutoff A of the 1924 report, and by excavating that cutoff. This extension puts the outlet end of the diversion more than a mile downstream from the mouth of Yellow Creek. At present the crest flow of Yellow Creek, in times of high water, reaches its mouth practically at the same time with the crest flow of the Pecatonica. Consequently the river below cannot carry off the combined flood, and the water spreads all over the valley and back towards Freeport.

SHORTER CHANNEL PROPOSED.

With the above diversion completed, the length of the new channel from West Street to the final outlet would be about 3.1 miles, whereas the present stream measures over 7 miles between the same points. This change would result in a much better bottom grade and a much straighter channel; therefore the crest flow through the diversion should reach the outlet before the crest from Yellow Creek and eliminate considerable of the backwater flooding of the valley.

The bottom width of the diversion channel would be the same—200 feet—as proposed in the 1924 report, but after a further study of

Chicago, Milwaukee & St. Paul Freight House. Freeport Flood, March 16, 1929.

Pecatonica River Flood at Freeport, current across Stephenson Street.

the banks and their erosive qualities, the writer deems that a slope of one horizontal to one vertical would be sufficient instead of two to one as used in 1924.

Again, judging by current prices for dredging and excavating, the cost per cubic yard may be lowered to 15 cents instead of 20 cents.

In Project 2, for complete diversion, two earthen dams would be necessary in the abandoned channel. One would be located just below the upper end of the diversion to turn the water from its present course into the new channel. The other would be located just above the point in the eastern part of town where the diversion utilizes the present stream, to prevent the water from turning upstream in the old channel and backing up toward the city. In both cases the dams would be constructed of material taken from the excavated channel. It is possible that a concrete slab facing would be necessary on the water side to prevent erosion.

ESTIMATED COST OF PROJECT 2.

An approximate estimate of the cost of Project 2, exclusive of any work on the abandoned part of the river except as indicated above, now follows:

Excavation, 2,100,000 cubic yards @ 15 cents	$315,000.00
Right of way	35,000.00
Buildings razed or removed	10,000.00
Bridges	180,000.00
Earth dams	15,000.00
Goddard's Dam rights	15,000.00
Miscellaneous damages	10,000.00
Total	$580,000.00
Overhead 10%	58,000.00
	$638,000.00
Contingencies 5%	31,900.00
Total cost	$669,900.00

PROJECT 3—USING BOTH PRESENT CHANNEL AND DIVERSION.

By this project, the river, from West Street bridge to the point of diversion would have to be widened to the full 200 feet. From this point the present stream would be utilized for most of the normal or ordinary flow, and the excess water would go through the diversion.

The diversion channel would be on the same course as in Project 2 but would have a bottom width of 125 feet instead of 200 feet. The grade of this channel would also be the same as that of Project 2, which is .0004 or 2.112 feet per mile. This would make the bottom of the diversion at the upper end about three feet higher than the river bottom and would cause a much higher velocity in it than in the channel through town.

At the upper end of the diversion channel a concrete spillway should be constructed the full 200 foot width of the enlarged river, with wingwalls and apron narrowing down gradually to the 125 foot width of the channel.

The crest of this spillway should be about at elevation 745, which would insure water going through both channels, at all times, so there would never be stagnant water in either channel.

SOME ADVANTAGES OF THIS PLAN.

The diversion channel is calculated to carry about 14,000 C. F. S. and the present channel about 7,000 C. F. S. at times of the assumed maximum flood.

On the present channel, as utilized by Project 3, Goddard's dam would be removed, and sufficient dredging would be done to furnish material for levees on all banks where necessary to insure against any overflow. It is expected however that the crest flow would be, at all times, lower than the low steel of any of the bridges now existing on the river.

At the east end of Freeport, below the Chicago & North Western bridge, the proposed flow through the present channel would pass through the 400-foot cutoff as in Project 1, and empty into the present river at the east end of that cutoff.

In this way, the flow through this channel would enter the unimproved stream above the mouth of Yellow Creek, while the diverted flow would outlet a mile below Yellow Creek.

In Project 3, as in Project 2, an earthen dam would be necessary just above the point where the diversion channel utilizes the river in the eastern part of the city, and the same remarks will apply to it as were made above.

APPROXIMATE COST OF PROJECT 3.

The approximate estimate for Project 3, is as follows:

Excavation, 1,365,000 cubic yards @ 15 cents	$204,750.00
Right of way	30,000.00
Buildings razed or removed	20,250.00
Bridges	150,000.00
Goddard's Dam rights	15,000.00
Present channel dredging and levees	30,000.00
Excavating short cutoff	5,000.00
Earth dam	10,000.00
Concrete spillway and apron	25,000.00
Total	$490,000.00
Overhead 10%	49,000.00
	$539,000.00
Contingencies 5%	26,950.00
Total cost	$565,950.00

COMPARISON OF PROJECTS.

Project 1, for widening the present river to carry all flow, would entail the lengthening or reconstruction of all bridges, with the consequent interruption to commerce, rail traffic and local business; it would require the removal or razing of some manufacturing and business buildings; the cost would be the heaviest, and after completion, it would prove the most vulnerable and subject the community to greater damage in case of a flood should occur greatly in excess of the 21,000 C. F. S. flow which has been assumed as the probable maximum.

Project 2, for complete diversion, would take all of the water from the river away from the present channel through the city, and theoretically would be the best solution of the problem. It would, however, be subject to one great drawback due to the fact that the present bed of the river would be empty except for the storm drainage and sewage from the city itself. While the area now taken up by the stream could be made very valuable, for manufacturing railroad and business purposes, it would

necessitate a further heavy expense for the construction of a large combined sewer along the bottom and for the filling of material over the sewer to bring it up to the city grade. Without this, the stream would soon become very obnoxious and unsightly, and would be a menace to health. Until the construction of this sewer and the filling of the channel could be accomplished, it would be advisable to let a generous amount of water go down through the channel to avoid creating this bad condition.

PROJECT 3, CHEAPEST AND MOST PRACTICAL.

Project 3, combined river and diversion channel, would insure the city from future floods. The storm sewer, which would be necessary in Project 2, would not be required, although within a few years, a smaller sewer, which probably would be built on land, will be required to carry the sanitary sewage to a treatment plant in some location downstream. Project 3 would not require the purchase or condemnation of so much land for right-of-way. It would not require changes in the present bridges, although in some cases changes would be desirable.

On the other hand, Project 3 would necessitate bridges on each channel, with a consequent increased cost of maintenance. The approximate cost of this project, as shown above would be less than either of the other projects.

CONCLUSION AND RECOMMENDATION.

In the opinion of the writer, while Project 2 would be theoretically the best eventually, the fact that it would take a long time and a great additional expense to install the storm sewer and fill the unused stream bed seems to eliminate that project.

Project 1 would also eliminate itself because of the high cost and because of the other reasons stated above.

Project 3, in the opinion of the writer, is the most practicable, the least costly and the easiest to construct; therefore his conclusion is that Project 3 is the one to be adopted and carried out, if the work is to be undertaken in the near future.

State of Illinois
Department of Purchases and Construction
Division of Waterways
REVISED MAP SHOWING
PROPOSED CHANGE IN PECATONICA RIVER
AT
EAST FREEPORT, ILLINOIS
TO ACCOMPANY REPORT ON PECATONICA FLOOD PROTECTION
By: W.G. Potter
Drainage Engineer
Scale
1929
PECATONICA
RIVER
TAYLOR
PARK
CENTER LINE OF PROJECT "B"
CENTER LINE OF PROJECT "C"
CUT OFF FOR PROJECT 1
ILLINOIS CENTRAL RAILROAD
SHOPS
Slough

PUBLICATIONS FOR DISTRIBUTION BY THE DIVISION OF WATERWAYS.

Issued by the Rivers and Lakes Commission of Illinois, 1911–1916.

BULLETINS.

No. 1. The Conservation of Water Power in the DesPlaines and Illinois Rivers and the Improvements of these Rivers for Navigation. 1911.

No. 2. Prospectus of a project for a Deep Waterway and conservation of natural resources of the State of Illinois, prepared by Lyman E. Cooley. 1911.

No. 3. Uses of the Great Lakes. 1912.

No. 4* Land Drainage in Illinois, by Robert Isham Randolph. 1913.

No. 5. A compilation of money spent by the Government on various Harbors, Rivers and Canals, and the riparian property holders benefited. 1912.

No. 6. Argument on behalf of the State of Illinois supporting the prayer of the Sanitary District of Chicago for a permit to take 10,000 cubic feet of water per second from Lake Michigan, by Isham Randolph. 1912.

No. 7.* The 1912 Flood on the Lower Mississippi, by A. L. Dabney, Consulting Engineer, and "The 1912 Flood in the Ohio and Mississippi Rivers," by H. C. Frankenfeld. 1912.

No. 8. Proceedings of the organization meeting of the Association of the Mississippi Valley States for river control. 1912.

No. 9. The Illinois Water Power Waterway. 1912.

No. 10. The Illinois Waterway—a Guide for Navigators from Lake Michigan to the Mississippi River via the Chicago Sanitary and Ship Canal, the Illinois and Michigan Canal and the Illinois River. Also an Alternate Route via the Illinois and Mississippi Canal. Fifth edition. 1928.

No. 11.* European Harbor Development, by Robert R. McCormick. 1912.

No. 12.* Common Sense applied to the Inland Waterway Problem, by Robert R. McCormick. 1912.

No. 13. The Illinois Waterway, a Review, by Isham Randolph. 1912.

No. 14. Water Resources of Illinois—a cooperative report prepared by Rivers and Lakes Commission and A. H. Horton, District Engineer of the United States Geological Survey. 1914.

No. 15.* The Illinois Waterway—a project for a waterway of eight feet minimum depth between Lockport and Utica and available for immediate construction. 1914.

No. 16.* Stream Pollution and Sewage Disposal in Illinois with Reference to Public Policy and Legislation, by LeRoy K. Sherman. 1915.

No. 17.* Report of Survey and Investigation of LaMoine River, with Reference to Flood Control and Navigation.

No. 18.* Flood Control for Pecatonica River. 1916.

No. 19.* Projects for a Navigable Waterway from Southern Illinois Coal Fields to Mississippi River. 1917.

No. 20.* The Illinois Waterway Report, with plans and estimates of cost of a deep Waterway from Lockport to Utica by way of the DesPlaines and Illinois Rivers. Internal Improvement Commission. 1909.

No. 21.* Surface Water Supply of Illinois. Internal Improvement Commission. 1908–1910.

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No. 23. Report from the prevention of overflow of the Little Wabash and Skillet Fork Rivers. 1911. Postage, 16 cents.

No. 24. The Illinois River and its Bottom Lands, by Alvord and Burdick. 1915. Second edition, 1919.

No. 24½. *Report, map and profile of Fox River. 1915.

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*First Annual Report. 1917–18.

Second, Third, Fourth, Fifth, Sixth, Seventh, Eighth, Ninth, Tenth, Eleventh, Twelfth and Thirteenth Annual Reports. 1918–30, inclusive.

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Inland Waterways and Transportation Cost, by M. G. Barnes. 1920.

No. 25. Big Muddy River Report. 1922. (Also in Fifth Annual Report.)

No. 25½. Floods in Illinois. 1922. Causes, results and remedies. (Also in Fifth Annual Report.)

Pecatonica River Report. 1924. (See Seventh Annual Report.)

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No. 26. Calumet Lake and Chicago-Nickle Plate Agreement. 1926.

No. 27. Laws of Illinois relating to Waterways. 1926.

No. 28. National Aspect of Lakes-to-Gulf Waterway — Diversion of Waters from Lake Michigan—Boundary Waters, Treaty, etc. 1926.

No. 29. "Flood Control Report." 1929. An engineering study of the flood situation in Illinois, prepared under the direction of Wm. F. Mulvihill, Supervisor of Illinois Waterway Construction, and L. D. Cornish, Chief Engineer.

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* On file in office of Division of Waterways, Chicago. Supply for distribution exhausted.

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